GAUTENG PROVINCE
AGRICULTURE AND RURAL DEVELOPMENT
REPUBLIC OF SOUTH AFRICA

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Dear Ané Agenbacht

APPROVAL OF FINAL SCOPING REPORT AND PLAN OF STUDY FOR ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF PWV 17 ROAD ON THE FARM ELANDSFONTEIN 412 (PORTION 75), GROOTFONTEIN 394 (PORTION 1) OR THE FARM TIEGERPOORT 371 (PORTIONS 2, 28, 245 AND 235), ZWAVELPOORT 373 (PORTION 299 AND THE REMAINDER OF PORTION 250), ZWAVELPOORT (PORTIONS 43 AND 34) ZWARTKOPPIES 364, CITY OF TSHWANE METROPOLITAN MUNICIPAITY

The Scoping Report and Plan of Study for Environmental Impact Assessment (EIA) which was submitted in respect of the above mentioned application and received by the Department on 9 February 2017 have been accepted. You may accordingly proceed with undertaking the EIA in accordance with the tasks that are outlined in the Plan of Study.

Please note that the Department also requires that the following be considered:

1. All specialist studies conducted and referred to in the Final Scoping Report (FSR) must be included in the Environmental Impact Assessment Report. These specialist studies also include Biodiversity Assessment, Wetland Delineation and /or Riverine Study, Visual Assessment, Heritage Impact Assessment, Social Impact Assessment, Noise Impact Assessment, Geotechnical Investigations and Stormwater Management Plan.
2. Based on the Gauteng CPlan Version 3, the proposed development will traverse Irreplaceable Area, Important Area and Sensitive Ecological Areas. An Ecological Assessment Report must be submitted to the Gauteng Department of Agriculture and Rural Development (GDARD).
3. The ecological specialist studies must meet the Department's Directorate of Nature Conservation requirements for biodiversity assessments.
4. The proposed route (Alternative 1) will traverse the Sesmylspruit and Swavelpoortspruit watercourses. All crossings of the watercourses must be indicated on the route plan.
5. With the consideration that the proposed routes will traverse the undeveloped parts of the Bronberg Ridge renowned for the occurrence of the threatened Juliana Golden Mole which is endemic to the ridge, it must clearly be stated how the Juliana Golden Mole will be protected from the impacts of the proposed route, particularly the borrow pits for technical investigation and blasting as well as drilling during the construction of the tunnel (as stated by the Friends of Faerie Glen Nature Reserve, FFGNR).
6. It is stated that there is a definite need for the south-north link in Pretoria. Taking into cognisance the attached locality plan (figure 2 of the report) in the Final Scoping Report (FSR), GDARD is confused as to how there will be a link between Heildelberg and Limpopo considering the fact that the proposed route ends in the developed township of Hatherly.

7. All alternatives identified in the Final Scoping Report must be assessed and provided in more detail during the submission of a Draft and Final Environmental Impact Assessment Report which includes appropriate mitigation measures. GDARD is of the view that the proposed development must align more to the west where it is at least less sensitive.
8. The revised route plan must indicate the proposed PWV 17 in relation to the existing roads along the Bronberg which includes the R25 and Solomon Mahlangu and all the environmental sensitivities found along the proposed route alignment.
9. Further, consider to incorporate the findings and recommendations of all specialist studies undertaken when designing the final route plan.
10. It was be noted that a storm water management plan will also be undertaken as part of EIA and it must comply with the standard and requirements of the City of Tshwane Roads and Stormwater Division.
11. All issues raised by interested and affected parties which include the Friends of Faerie Glen Nature Reserve (FFGNR) must be addressed on the Environmental Impact Assessment Report and an updated Comment and Response Report must be included.
12. Both adverts published on 13 November 2015 and 17 November 2016 including site notices must be appended in the EIA Report.
13. A comprehensive and site specific Environmental Management Program (EMPr) for the proposed activity (construction and operational phases) must be compiled and included in the Environmental Impact Assessment Report. The EMPr must include a discussion on mitigation measures for all potential impacts as well as the persons responsible for implementing such measures.

If you have any queries regarding the contents of this letter, contact the official at details indicated above.

Yours faithfully

Mr. Teboho Leku
Acting Director: Impact Management
Date: 28/02/2017

Annexure E

Specialist Studies

Annexure E (i)

Fauna and Flora

FAUNA HABITAT ASSESSMENT FOR OF PORTIONS ON THE FARM TWEEFONTEIN 19, FARM HATHERLEY 331, FARM ZWARTKOPPIES 364, FARM MOOIPLAATS 367, FARM TIEGERPOORT 371, FARM ZWAVELPOORT 373, FARM GROOTFONTEIN 394, FARM ELANDSFONTEIN 412 AND FARM TWEEFONTEIN 413, GAUTENG

February 2016

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Report Authors: **CW Vermeulen; SE van Rooyen; MI Cooper**

Reviewed: **Reinier F. Terblanche**

Specialists

Specialist investigators: Mr. S.E. van Rooyen (M.Sc. candidate); CW Vermeulen (B.Sc. Biological and Environmental Sciences); and MI Cooper (M.Sc.)

Declaration of independence:

The specialist investigators responsible for conducting this particular specialist vegetation study declare that:

• We consider ourselves bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);

• At the time of conducting the study and compiling this report we did not have any interest, hidden or otherwise, in the proposed development, except for financial compensation for work done in a professional capacity;

• Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, we will not be affected in any manner by the outcome of any environmental process of which this report may form a part;

• We declare that there are no circumstances that may compromise our objectivity in performing this specialist investigation. We do not necessarily object to or endorse the proposed development, but aim to present facts, findings and recommendations based on relevant professional experience and scientific data;

• We do not have any influence over decisions made by the governing authorities;

• We have the necessary qualifications and guidance from professional experts (registered Pr. Nat. Sci.) in conducting specialist reports relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;

• This document and all information contained herein is and will remain the intellectual property of Bokamoso Environmental: Specialist Division. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the specialist investigators.

• We will comply with the Act, regulations and all other applicable legislation;

S.E. van Rooyen

CW Vermeulen

MI Cooper

Review of

Fauna Habitat Assessment for the remaining extent of Portion 1 of the Farm Waterfall 5-IR, Gauteng Province of March 2016

Review: May 2016

Reviewer: Reinier F. Terblanche

(M.Sc, *Cum Laude*; Pr.Sci.Nat, Reg. No. 400244/05)

APPROACH OF REVIEWER TO ECOLOGICAL REVIEWS

Ecological studies and applied ecology comprise the consideration of a diversity of factors, even more so in South Africa with its exceptional high floral and faunal diversities, various soil types, geological formations and diversity of habitats in all its biomes. Therefore it would be easy to add onto or show gaps in any ecological impact assessment, rehabilitation actions or management plans stemming from ecological assessments. The approach followed here is to review the ecological study in a reasonable context and focus on the successful fulfillment of the aims of the study within the limits of cost and time.

ECOLOGICAL REVIEW: FAUNA HABITAT ASSESSMENT FOR THE REMAINING EXTENT OF PORTION 1 OF THE FARM WATERFALL 5-IR, GAUTENG PROVINCE OF MARCH 2016

Findings of the review

- The report contains details of the expertise of the persons who prepared the report and a declaration that the person who prepared the report is acting independently.
- The aims of the report are clear.
- The report provides references and descriptions of the principles and guidelines to be taken into account for fauna habitat assessment.
- Acceptable methods and limitations have been given in detail to reach the goal of the assessment.
- Relevant laws and guidelines have been mentioned and integrated.
- The report gives a clear assessment of the status fauna at the site and also added an extensive literature survey and existing knowledge survey.
- The recommendations and the conclusion are consistent with the aims of the report.
- It is to be commended that the report is economical and practical so that it adds value to the team effort of addressing the management and future of the habitats at the site. Also to be commended is the awareness to involve an extra specialist study to assess the likely presence or not of *Neamblysomus julianae*.

Overall the report appears to be relevant, detailed enough for the purposes of this study and complete and finally addressing the key issues at stake.

Reinier F. Terblanche M.Sc. Ecology; Pr.Sci.Nat, Reg. No. 400244/05

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FIGURES:

1. INTRODUCTION

Bokamoso Environmental Consultants CC; Specialist Division was appointed to conduct a Basic Faunal Assessment for the proposed road development known as PWV 17, on the remaining extent of portions on the farm Tweefontein 19, farm Hatherley 331, farm Zwartkoppies 364, farm Mooiplaats 367, farm Tiegerpoort 371, farm Zwavelpoort 373, farm Grootfontein 394, farm Elandsfontein 412 and farm Tweefontein 413, Gauteng. This report is based on the faunal species present on the study area as well as species that could potentially occur. The report acts as an overview of the probable and/or known occurrence for following faunal groups; Mammals, Reptiles, Amphibians and Invertebrates. Avifauna is not included in this report, as a separate avifaunal assessment was conducted for the study area. The primary focus of this report falls on Red Data species and other species with conservation importance occurring on or near the study area to ensure that, should any such species exists, the appropriate actions are taken to guarantee the well-being of these species.

2. SCOPE AND OBJECTIVE OF ASSESSMENT

- To qualitatively and quantitatively assess the significance of the faunal habitat components and current general conservation status of the property
- Comment on ecological sensitive areas within the study area
- Comment on connectivity with natural vegetation and homogeneouse habitats surrounding the study area.
- To provide a list of faunal species (mammals, herpetofauna and invertebrates) which occur or might occur, and to identify species of conservation importance
- To highlight potential impacts of the proposed development on the fauna of the study area, and

To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.

3. STUDY AREA

The study area is situated on the remaining extent of portions on the farm Tweefontein 19, farm Hatherley 331, farm Zwartkoppies 364, farm Mooiplaats 367, farm Tiegerpoort 371, farm Zwavelpoort 373, farm Grootfontein 394, farm Elandsfontein 412 and farm Tweefontein 413, Gauteng. The size of the study area is approximately 6400 ha and is located within the 2528CD quarter degree square (QDS). The study area is located in the Rand Highveld Grassland (RHG), Andesite Mountain Bushveld (AMB) and Marikana Thornveld (MT). The

AMB can be further broken down into smaller vegetation units of which the Bronberg Mountain Bushveld (Government Gazette no. 34809, 2011) overlaps the study area. The study area is situated between the R25 in the South, close to the town Bapsfontein and the N4 highway to the North, next to Silver Lakes Estate (**Figure 1**). The proposed road alignment crosses several existing roads including the R50 Delmas Road, the M30 Garsfontein Road, M6 Graham Road and the R631 Boschkop Road. As the study area crosses three different vegetation units, it varies from extensive sloping plains and a series of ridges slightly elevated over undulating surrounding plains to valleys and some lowland hills. The most common grasses on the plains belong to the genera *Themeda, Eragrostis, Heteropogon* and *Elionurus*. High diversity of herbs, many of which belong to the Asteraceae, is also a typical feature. Rocky hills and ridges carry sparse (savannoid) woodlands with *Protea caffra* subsp. *caffra, P. welwitschii, Senegalia caffra* and *Celtis africana*, accompanied by a rich suite of shrubs among which the genus *Searsia* (especially *S. magalismonata*) is most prominent (Mucina and Rutherford, 2006). The Marikana Thornveld is dominated by stands of open *Vachellia karroo* woodland, occurring in valleys and slightly undulating plains (Mucina and Rutherford, 2006).

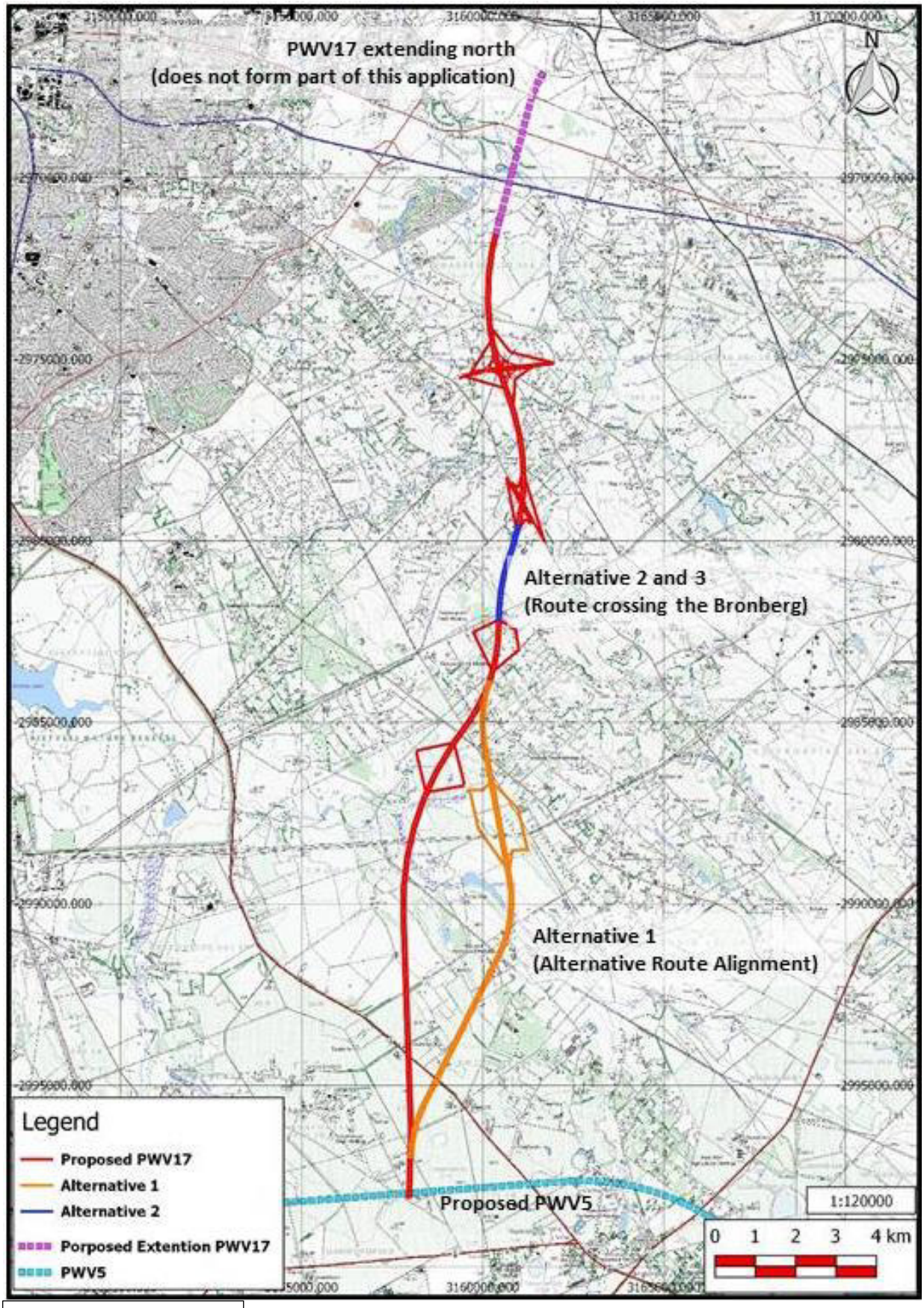

Figure 1: Locality Map

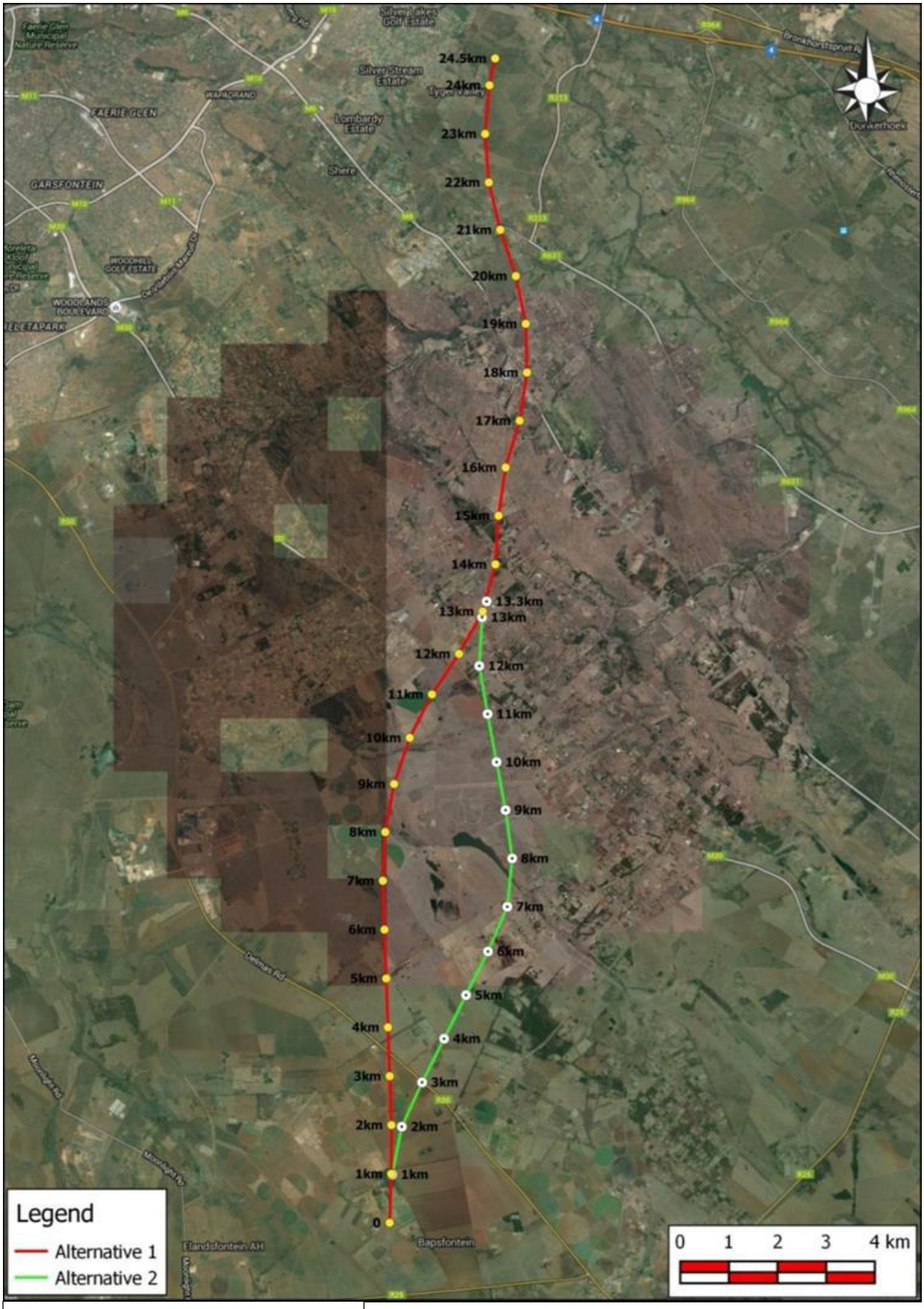

Figure 2: Arial photo of study area

4. METHODS

Before conducting a field survey on the study area a desktop assessment was conducted to note the prevalent faunal species occurring on or near the site. A list of expected species was compiled and used as a reference during the field survey to ensure that species that should theoretically occur were not overlooked. All distinct faunal habitats were identified on site, after which each habitat was assessed to record the associated faunal species for each of the respective faunal groups (Herpetofauna, Invertebrates and Mammals) present in that specific habitat.

5. RESULTS

During the habitat assessment eight distinct habitats were identified in the study area. These habitats include: (**Figure 3**)

1. Near Natural Grassland
2. Wetland
3. Rocky Ridge
4. Savanna Grassland
5. Woodland
6. Riverine Area
7. Mixed Residential and Agricultural
8. Urban Area

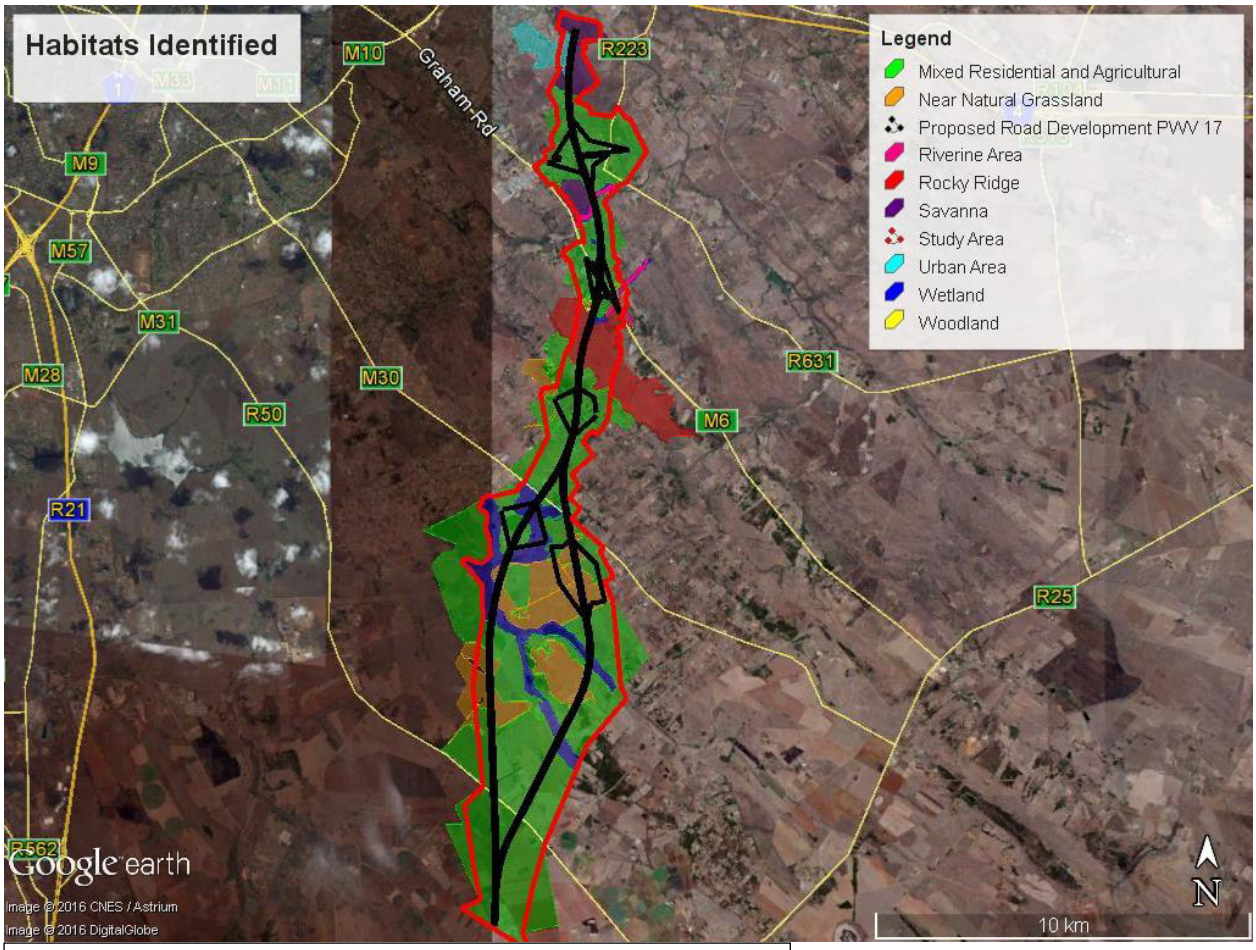

Figure 3: Habitats identified within the study area

5.1 Near Natural Grassland

The Grassland habitat contains several dominant Highveld graminoid species including *Hyparrhenia hirta, Heteropogon contortus, Themeda triandra* and *Eragrostis* spp. (**Figure 4**). This grassland, which is highly variable in species composition, is regarded as Endangered (Mucina and Rutherford, 2006) due to its high species richness of graminoids and forbs. This grassland has several study units that still remains in its pristine and primary condition, which is thought to support a high variety of widespread fauna species. As a result of the current, natural status of the aforementioned grassland habitats, it is deemed highly sensitive from a faunal perspective, as it creates suitable habitats for several fauna species. The rest of the grassland study units has been altered by human disturbances and is therefore deemed moderate sensitive, as it still provides suitable habitats for several fauna species. Connectivity of the Grassland Vegetation unit with surrounding homogenous grassland habitats is mandatory to ensure sustainable demographic patterns of the fauna species relying on this habitat for survival. Connectivity of the habitat unit with surrounding homogenous habitats is relatively good throughout the study area. On account of the aforementioned connectivity function, optimal habitat for threatened faunal species, natural

state of the habitat and species composition the largest part of this habitat was deemed to be moderately sensitive from a faunal perspective. One section of this habitat unit was deemed to be highly sensitive as it is located between two highly sensitive wetland sections and connects two of the three large near natural grassland habitats in the southern portion of the study area.

Figure 4: Near Natural Grassland Vegetation

5.2 Wetland

The Wetland Vegetation unit encompasses the ideal habitat for wetland-associated fauna (**Figure 5**). The largest part of this study unit experience minimal to no disturbances, which results in a highly sensitive area, creating suitable habitats for especially wetland associated mammals and amphibian species (**Figure 7**). Most of the vegetation in the Wetland Vegetation unit is dominated by indigenous graminoid, sedge and forb species such as *Berkheya radula, Cypress* spp., *Sporobolus africanus* and *Typha capensis.* However, a few areas in the Wetland Vegetation unit experience encroachment of alien species, such as *Campuloclinium macrocephalum*, which threatens the natural wetland ecosystem (**Figure 6**).

The larger study area contains a number of scattered wetlands some of which forms part of surrounding rivers and streams and some forming part of man-mad dams and natural drainage lines and seepage area. The largest wetland is situated on the southern section of the study area and contains one big dam and a few smaller dams connected by vast stretches of natural wetlands. This habitat is dominated by palustrine vegetation such as *Cyperus* spp., *Schoenoplectus* spp. and *Typha capensis*.

Due to the majority of the Wetland Vegetation unit remaining in its pristine condition, it is deemed highly sensitive. Connectivity of the Wetland Vegetation unit with surrounding homogenous wetland habitats is mandatory to ensure sustainable demographic patterns of the fauna species, especially amphibian species, relying on this habitat for survival.

Figure 5: Wetland Vegetation

Figure 6: Wetland Vegetation dominated by Pom-pom weed

Figure 7: Wetland Vegetation adjacent to the Grootdam

5.3 Rocky Ridge

The Rocky ridge habitat unit is situated in the middle of the study area between Graham Road and Garsfontein Road. This habitat remains in its pristine condition with a high endemic species richness regarding herbaceous as well as woody vegetation layers, as it forms part of the as Critically Endangered Bronberg Mountain Bushveld vegetation unit (Government Gazette no. 34809, 2011) (**Figure 8**). The ridge is commonly known as Bronberg and is a Class 2 which is described as a ridge of which more than 5%, but less than 35%, of their surface area has been converted to urban development, quarries and/or alien vegetation. The implications of the classification of this study unit's as a Class 2 ridge is stipulated in the Gauteng Ridge Police of 2006, revised. The Rocky Ridge Vegetation unit is expected to support a large number of faunal species. The reason for the expected high species richness in this area is a direct result of the occurrence of a number of large indigenous trees (mainly *Searsia lancea, Searsia magalismontana, Diospyros lycioides* subsp. *lycioides, Combretum molle* and *Searsia pyroides*), which provide foraging and roosting habitat for a variety of arboreal, grassland and savanna fauna species. The Rocky Ridge Vegetation unit also provides all the desirable nooks and crannies which will favour rupiculous faunal species.

On account of the pristine natural faunal habitat and the critical connectivity function fulfilled by this study unit the habitat was deemed to be highly sensitive from a faunal perspective. Connectivity of this Rocky Ridge Vegetation unit with surrounding homogenous Rocky Ridge Vegetation unit habitats is mandatory to ensure sustainable demographic patterns of the fauna species relying on this habitat for survival.

Figure 8: Rocky Ridge Vegetation

5.4 Savanna Grassland

The Savanna Grassland study unit experience minimal disturbances, but still remains fragmented. Insulation threatens this habitat as connectivity with homogenous habitats is limited. This hinders the movement of several fauna species, which will ultimately result in poor gene distribution as inbreeding among fauna species follows. The current status of this habitat is good with minimal disturbances such as cycle tracks, roads and fences (**Figure 9**). This habitat falls in the Vulnerable Marikana Thornveld vegetation unit, which is dominate by *Searsia* spp., *Vachellia* spp. and *Diospyros lycioides* subsp. *lycioides.* These species provide foraging and roosting habitat for a variety of arboreal, grassland and savanna fauna species.

The largest part of this study unit remains in a natural state with moderate connectivity to the east. The occurrence of threatened and near threatened fauna species is questionable due to the various developments and man-made activities in the surrounding areas. On account of the near natural state of the study unit together with the overall high fauna species composition, this study unit was deemed moderately sensitive from an faunal perspective.

Figure 9: Savanna Grassland.

5.5 Woodland

This habitat is situated on the northern slope of the Bronberg Mountain Bushveld vegetation unit and is regarded as high ecological sensitive due to its natural status and good connectivity with the adjacent Bronberg Mountain Bushveld, which is regarded as Critically Endangered (**Figure 10**). Although it encompasses a fairly small part of the larger study area, it is expected to support a large number of faunal species. The reason for the expected high species richness in this small area is a direct result of the occurrence of a number of large indigenous trees (mainly *Vachellia karroo, Combretum molle, Dombeya rotundifolia, Ficus salicifolia* and *Celtis africana*), which provides foraging and roosting habitat for a variety of arboreal, grassland and savanna species.

Figure 10: Woodland Vegetation.

5.6 Riverine Area

The riverine vegetation habitat unit is located at the sections where the proposed road development intersects the Zwavelpoort spruit and Pienaars River. Both of the aforementioned watercourses are classified as perennial rivers (**Figure 11**). Due to large number of faunal species preferring this unique habitat type, the riverine area was expected to produce the highest species richness in comparison with the other habitats in the study area. This riverine habitat experience minimal disturbances from urban and agricultural development, but is however threatened by the invasion of alien species such as *Acacia mearnsii, Arundo donax* and *Celtis australis.* Currently the riverine habitat is dominated by indigenous species such as *Combretum erythrophyllum, Vachellia karroo, Ziziphus mucronata, Phragmites australis, Searsia lancea* and *Typha capensis,* which creates suitable habitats for a wide variety of fauna species (**Figure 11**). A few Red Data species also prefer riverine areas as suitable habitats. The probability of these species located in the riverine habitat is highly likely due to the sustained connectivity with homogenous habitats and good ecological status of this habitat.

Figure 11: Riverine Area.

5.7 Mixed Residential and Agricultural

The largest part of the study area consists of this habitat type. As with the urban habitat, a large number of fauna species have adapted to this transformed habitat (**Figure 12**). This habitat is largely transformed due to agricultural activities and contains areas ranging from cultivated land to livestock farming as well as large open pastures. Although this habitat might occasionally be utilized for foraging purposes by threatened and near threatened species, no suitable habitat for any threatened or near threatened faunal species were observed, as such the area cannot be deemed sensitive solely on account of the sporadic and occasional presence of these species.

Due to the agricultural zoning of most of the properties overlapping the study unit it is reasonable to anticipate that large open spaces will still be available for the purpose of foraging habitat for various fauna species, should the proposed road development take place. As a result of the lack of suitable breeding habitat for threatened and near threatened fauna species, as well as the numerous disturbances associated with agricultural activities, this habitat type was deemed to have a reasonably low faunal sensitivity.

Figure 12: Mixed Residential and Agricultural

5.8 Urban Area

As with the Mixed Residential and Agricultural habitats, a large number of fauna species have adapted to this transformed habitat (**Figure 13**). This habitat is largely transformed on account of urbanisation. Urbanised areas do not provide suitable habitats for Red List fauna species as the natural habitat has been transformed and destroyed, as such the area cannot be deemed sensitive. Several species however have adapted to this habitat as they forage mainly on garbage and alien plants associated with urban areas.

Figure 13: Urban Area.

6. MAMMAL HABITAT ASSESSMENT

This part of the report focuses on the probable and/or known occurrence of Threatened mammal species as well as mammal species with conservation concern based on the habitats present on the study area.

Special attention was paid to the evaluation of the quantitative and qualitative habitat conditions of Red Data species judged to have a probable occurrence on the site. Mitigation measures to lesser the impacts and effects of the proposed development were suggested where applicable. The secondary objective of this investigation was to gauge which mammals might still reside in the study area and to compile a complete list of mammal diversity.

6.1 Methods

The study area survey was conducted on the 18th, 19th and 25th of February, the 2nd of March and the 22nd of April 2016 during which all observed mammal species as well as all the potential mammal habitats on the study site were identified. Following the field survey a desktop assessment was conducted to add additional mammal species expected to occur on the study site on account of their individual habitat preferences in accordance with the habitats identified on the study area. Mammal occurrence probability can be attributed to the well recorded and known distributions of South African mammals as well as the quantitative

and qualitative nature of the habitats present on site. Moreover the 500 meters surrounding the study area were scanned for any additional faunal habitats.

Field Survey

Before the commencement of the field survey a list of expected mammal species was compiled to use as a reference in the field. All the threatened and sensitive mammals with distribution ranges overlapping the study area were included in the aforementioned reference list. These species were prioritized and special attention was paid in terms of identifying their associated habitat preferences and noting signs of their occurrence. The field survey was conducted by means of random transect walks within each habitat. During the field survey mammal species were identified in accordance with individual habitat preferences as well as actual observations and signs such as; spoor, droppings, burrows and roosting sites indicating their presents (Chris & Tilde Stuart, 2011).

Desktop Survey

Due to the fact that the majority of mammals are either nocturnal, hibernators, secretive and/or seasonal it is increasingly difficult to confirm their presence or absence by means of actual observations alone. Therefor a number of authoritative tomes such as field guides, databases and scientific literature were utilized to deduce the probable occurrence of mammal species. The Animal Demography Unit: Virtual Museum (http://vmus.adu.org.za/) was consulted to verify the records and occurrence of recorded mammal species within the QDS 2628AA. The Gauteng Conservation Plan (C-plan v3.3) was consulted to evaluate ecologically sensitive areas associated with mammals. A comprehensive list of probable mammalian occurrence with reference to the study area was compiled on account of the well-known and documented distributions of mammals in South Africa, especially in the Gauteng province.

The occurrence probability of mammal species was deduced in accordance with a species' distribution and habitat preferences. Where a species' distribution range was found to overlap with the study area and its preferred habitat was present, the applicable species was deemed to have a high occurrence probability on or near the study area.

In the case where the preferred habitat of a species' were found to be suboptimal on the study area, however its distribution range still overlapped the study area, the applicable species' occurrence probability was deemed to be medium.

When the habitat preferences of a species were absent from the site, the applicable species was deemed to have a low occurrence probability regardless of its distribution range.

6.2 Specific Requirements

During the field survey attention was paid to note any signs of potential occurrence of threatened and sensitive species as well as species associated with wetlands, rivers and ridges.

These species include:

Vlei rat (*Otomys irroratus*), Angoni vlei rat (*Otomys angoniensis*), African march rat (*Dasymys incomtus*), Water mongoose (*Atilax paludinosus*), African clawless otter (*Aonyx capensis*), Spotted-necked otter (*Lutra maculicollis*), Juliana's golden mole (*Neamblysomus julianae*), Rough-haired golden mole (*Chrysospalax villosus*), Highveld golden mole (*Amblysomus septentrionalis*), Rock dormouse (*Graphiurus murinus*), Forest shrew (*Myosorex varius*), other shrew species, White-tailed rat (*Mystromys albicaudatus*), Short-eared trident bat (*Cloeotis percivali*) and other cave-dwelling bats.

6.3 Results

6.3.1 Mammal habitats identified

During the habitat assessment six distinct mammalian habitats were identified in the study area. These habitats include: Near Natural Grassland, Wetland, Rocky Ridge, Savanna Grassland, Woodland and Riverine Area (**Figure 4**).

The Near Natural Grassland has several study units that still remains in its pristine and primary condition, which is thought to support a high variety of widespread fauna species. As a result of the current, natural status of the aforementioned grassland habitats, it is deemed highly sensitive from a mammal perspective, as it creates suitable habitats for several important mammal species. These species include Southern African Hedgehog, Serval, Honey Bager and Brown hyaena. Other common species associated with Grassland habitats include Southern African Hedgehog, Black-backed Jackal, Black Wildebeest, Red Hartebeest, Springbok, Yellow Mongoose, Plains Zebra, Waterbuck, Steenbok and Meerkat (**Table 1**). Connectivity of the habitat unit with surrounding homogenous habitats is relatively good throughout the study area. On account of the sustained connectivity function, optimal habitat for threatened faunal species, natural state of the habitat and species composition

the largest part of this habitat was deemed to be moderately sensitive from a mammal perspective. One section of this habitat unit was deemed to be highly sensitive as it is located between two highly sensitive wetland sections and connects two of the three large near natural grassland habitats in the southern portion of the study area.

The Wetland Vegetation unit encompasses the ideal habitat for wetland-associated mammal species. The largest part of this study unit experience minimal to no disturbances, which results in a highly sensitive area, creating suitable habitats for especially wetland associated mammal species. These species include Cape Clawless Otter, Angoni Vlei Rat and Southern African Vlei Rat (**Table 1**). Due to the majority of the Wetland Vegetation unit remaining in its pristine condition, it is deemed highly sensitive. Connectivity of the Wetland Vegetation unit with surrounding homogenous wetland habitats is mandatory to ensure sustainable demographic patterns of the mammal species relying on this habitat for survival.

The Rocky Ridge habitat remains in its pristine condition with a high endemic species richness regarding herbaceous as well as woody vegetation layers, as it forms part of the as Critically Endangered Bronberg Mountain Bushveld vegetation unit. No pockets of deep sand were found to be present on the study area; as such the occurrence of golden moles is highly unlikely. A specialist researcher on Juliana's golden mole (*Neamblysomus julianae*) was consulted to evaluate the area of proposed impact to the Bronberg Mountain Bushveld, for the occurrence of these species. According to him no suitable habitats for the Juliana's golden mole (*Neamblysomus julianae*) were observed on the particular area of impact, as well as in a 500m buffer area (**Annexure A**).

The Rocky Ridge habitat provides all the desirable nooks and crannies which will favour rupiculous mammal species. Due to the isolated nature and small surface area of the rocky outcrop it was not deemed to be an area of high ecological sensitivity. Species commonly associated with this Rocky Ridge is Rock Hyrax, Common Duiker, Scrub Hare, several Rat and Bat species (**Table1**). On account of the pristine natural faunal habitat and the critical connectivity function fulfilled by this study unit the habitat was deemed to be highly sensitive from a mammal perspective.

The Savanna Grassland study unit experience minimal disturbances, but still remains fragmented. Insulation threatens this habitat as connectivity with homogenous habitats is limited. This hinders the movement of several mammal species, which will ultimately result in poor gene distribution as inbreeding among fauna species follows. Species which prefer this habitat includes Yellow Mongoose, Steenbok, Common Duiker and Meerkat (**Table 1**). The occurrence probability of finding any Red List mammal species is low on account of the

limited connectivity with homogenous habitats and disturbances caused by urban development and recreation. On account of the aforementioned aspects, this habitat unit is regarded as moderate sensitive from a mammal perspective.

The Woodland habitat provides a micro-habitat within the Bronberg Mountain Bushveld vegetation unit. Although it is fairly small in size, a few mammal species still regard this habitat as suitable for roosting and foraging purposes. These species include Moholi Bushbaby (*Galago moholi*), several Bat species and Common Genet (*Genetta genetta*) (**Table 1**). Due to this habitat's sustained connectivity with the Bronberg, it is deemed moderate sensitive.

This riverine habitat experience minimal disturbances from urban and agricultural development, but is however threatened by the invasion of alien species. Due to this habitat's pristine condition, the probability of Red List species located in the riverine habitat is highly likely due to the sustained connectivity with homogenous habitats and good ecological status. These species include Vlei rat (*Otomys irroratus*), Angoni vlei rat (*Otomys angoniensis*), African march rat (*Dasymys incomtus*), Water mongoose (*Atilax paludinosus*), African clawless otter (*Aonyx capensis*), and Spotted-necked otter (*Lutra maculicollis*). This habitat unit is regarded as sensitive due to the sustained connectivity with homogenous habitats and good ecological status of this habitat.

6.3.2 Expected and observed Mammal species

Table 1: Mammals observed or expected to occur.

	Scientific Name	**Common Name**	**Red List Catagory**	**Occurrence Probability**
1.	*Atilax paludinosus*	Water mongoose	Least concern	5
2.	*Atelerix frontalis*	Southern African Hedgehog	Near Threatened	4
3.	*Aepyceros melampus*	Impala	Least Concern	3
4.	*Aethomys ineptus*	Tete Veld Aethomys	Least Concern	3
5.	*Aethomys namaquensis*	Namaqua Rock Mouse	Least Concern	4
6.	*Alcelaphus caama*	Red Hartebeest	Least Concern	5
7.	*Antidorcas marsupialis*	Springbok	Least Concern	5
8.	*Aonyx capensis*	Cape Clawless Otter	Least Concern	4
9.	*Canis mesomelas*	Black-backed Jackal	Least Concern	5
10.	*Connochaetes gnou*	Black Wildebeest	Least Concern	3
11.	*Crocidura*	Shrews	Not listed	3
12.	*Crocidura cyanea*	Reddish-gray Musk Shrew	Data Deficient	3
13.	*Crocidura hirta*	Lesser Red Musk Shrew	Data Deficient	3
14.	*Crocidura mariquensis*	Swamp Musk Shrew	Data Deficient	3
15.	*Cryptomys hottentotus*	Southern African Mole-rat	Least Concern	5
16.	*Cynictis penicillata*	Yellow Mongoose	Least Concern	5
17.	*Damaliscus lunatus*	Common Tsessebe	Least Concern	1
18.	*Damaliscus pygargus phillipsi*	Blesbok	Least Concern	5

19.	*Dasymys incomtus*	African Marsh Rat	Least Concern	4
20.	*Dendromus mystacalis*	Chestnut African Climbing Mouse	Least Concern	3
21.	*Elephantulus myurus*	Eastern Rock Elephant Shrew	Least Concern	4
22.	*Equus quagga*	Plains Zebra	Not listed	5
23.	*Galago moholi*	Moholi Bushbaby	Least Concern	3
24.	*Gerbilliscus brantsii*	Highveld Gerbil	Least Concern	3
25.	*Gerbilliscus leucogaster*	Bushveld Gerbil	Data Deficient	3
26.	*Herpestes sanguineus*	Slender Mongoose	Least Concern	3
27.	*Hyaena brunnea*	Brown Hyena	Near Threatened	5
28.	*Hystrix africaeaustralis*	Cape Porcupine	Least Concern	3
29.	*Kobus ellipsiprymnus ellipsiprymnus*	Waterbuck	Least Concern	3
30.	*Lemniscomys rosalia*	Single-Striped Lemniscomys	Data Deficient	3
31.	*Leptailurus serval*	Serval	Near Threatened	5
32.	*Lepus saxatilis*	Scrub Hare	Least Concern	5
33.	*Lutra maculicollis*	Spotted-necked otter	Near Threatened	4
34.	*Mastomys* sp.	Multimammate Mice	Not listed	4
35.	*Mastomys coucha*	Southern African Mastomys	Least Concern	3
36.	*Mellivora capensis*	Honey Badger	Near Threatened	3
37.	*Myosorex*	Mouse Shrews	Not listed	3
38.	*Myosorex varius*	Forest Shrew	Data Deficient	3
39.	*Neamblysomus julianae*	Juliana's Golden Mole	Vulnerable	1
40.	*Otocyon megalotis*	Bat-eared Fox	Least Concern	3
41.	*Otomys angoniensis*	Angoni Vlei Rat	Least Concern	4
42.	*Otomys auratus*	Southern African Vlei Rat	Not listed	4
43.	*Pipistrellus hesperidus*	Dusky Pipistrelle	Least Concern	3
44.	*Potamochoerus larvatus koiropotamus*	Bush-pig (subspecies koiropotamus)	Not listed	5
45.	*Procavia capensis*	Rock Hyrax	Least Concern	5
46.	*Proteles cristata*	Aardwolf	Least Concern	3
47.	*Raphicerus campestris*	Steenbok	Least Concern	5
48.	*Rattus rattus*	Roof Rat	Least Concern	4
49.	*Redunca arundinum*	Southern Reedbuck	Least Concern	3
50.	*Redunca fulvorufula*	Mountain Reedbuck	Least Concern	3
51.	*Rhabdomys pumilio*	Xeric Four-striped Grass Rat	Least Concern	4
52.	*Scotophilus dinganii*	Yellow-bellied House Bat	Least Concern	4
53.	*Suncus infinitesimus*	Least Dwarf Shrew	Data Deficient	3
54.	*Suricata suricatta*	Meerkat	Least Concern	3
55.	*Sylvicapra grimmia*	Common Duiker	Least Concern	5
56.	*Taphozous mauritianus*	Mauritian Tomb Bat	Least Concern	3
57.	*Thryonomys swinderianus*	Greater Cane Rat	Least Concern	3
58.	*Tragelaphus angasii*	Nyala	Least Concern	1
59.	*Tragelaphus oryx*	Common Eland	Least Concern	3
60.	*Tragelaphus strepsiceros*	Greater Kudu	Least Concern	3
61.	*Vulpes chama*	Cape Fox	Least Concern	3

*The occurrence probability of the mammal species listed above is indicated as follows:
Not likely to occur - 1, Low occurrence probability - 2, Medium occurrence probability - 3, High occurrence probability – 4, Confirmed occurrence – 5.
Red Data species ranked as defined in Friedmann and Daly's S.A. Red Data Book of the mammals of South Africa (2004).

6. 3.3 Threatened and Red Listed Mammal species

The listed shrews (**Table 1**) are not necessarily threatened; they are listed as a precautionary measure as a result of their unknown status. Musk shrews are widespread and commonly found in residential gardens throughout Gauteng, as such they are generally assumed to be abundant. The conservation status of musk shrews are however still to be determined and as such they are listed as Data Deficient. Vlei Rats are considered to be sensitive due to their intolerance to drought and their association with wetlands. Their reliance on wetlands serves as the main reason for their sensitive status.

Suitable habitats for otters were identified on the study area within the Riverine area as well as some stretches of the Wetland habitat unit. Thus it is recommended that minimal disturbances are permitted within the wetland and Riverine areas.

During the field survey no sign of otter activity was observed, however, their occurance probability was judged to be highly likely.

Two near threatened mammal species: Brown Hyaena (*Hyaena brunnea*) and Serval (*Leptailurus serval*), were confirmed to be present within the study area. Excluding the aforementioned near threatened mammal species confirmed to occur within the study area two additional threatened mammal species namely; Southern African Hedgehog (*Atelerix frontalis) and* Spotted-necked Otter (*Lutra maculicollis*), are expected to occur within the study area. Suitable bat roosts were observed in the Rocky Ridge and Woodland habitats, thus it can be expected that some of the threatened bat species are resident within the study area on account of the good connectivity and minimal disturbances of the Ridge habitat unit.

No other threatened or sensitive mammal species are thought to be present within the study area due to various factors such as man-made disturbances, transformed habitats, suboptimal habitat and restricted distribution ranges.

6.4 Findings

The Riverine, Wetland, Woodland and Rocky Ridge habitats are regarded as ecological sensitive on account of the natural state of the areas. These areas provide suitable habitats and foraging areas for several Red List mammal species. It is therefore not advised to cause disturbances, fragment or destroy these areas as it plays a major role in the sustainable wellbeing of especially Red Listed mammal species utilising these areas.

7. HERPETOFAUNA HABITAT ASESSMENT

7.1 Methods

The study area was visited on the 18th, 19th and 25th of February, the 2nd of March and the 22nd of April 2016. Habitat types identified in the study area was recorded, and a combined species list was compiled of the possible presence of herpetofauna species, considering the knowledge of their preferred habitats. Field guides such as those of du Preez & Carruthers (2009), Marais (2004), and Alexander & Marais (2007) were used for identification and habitat description of herpetofauna species.

A desktop study was done to identify suitable habitats for the Red List fauna species known to occur in the QDS 2528CD. The Animal Demography Unit: Virtual Museum (http://vmus.adu.org.za/) was consulted to verify the record of occurrence of herpetofauna species recorded within the QDS 2528CD. The Gauteng Conservation Plan (C-plan v3.3) was consulted to evaluate ecologically sensitive areas.

The majority of herpetofauna species are nocturnal, poikilothermic secretive and seasonal, which makes it difficult to observe them during field surveys. In this case the presence of herpetofauna species was examined on habitat preferred by selected species and respective documented ranges.

7.2 Specific Requirements

Adequate amount of random transect walks in the study site was attempted to identify herpetofauna and invertebrate species. Emphasis on specific Red List species that might occur on the study site:

- Striped Harlequin Snake (*Homoroselaps dorsalis*)
- Southern African Python (*Python natalensis)*
- Coppery Grass Lizard (*Chaemaesaura aenea*)

7.3 Results

7.3.1 Herpetofauna habitats identified

The open grassland, with no conspicuous standing or flowing water bodies in the study site, forms part of the terrestrial systems with ecological niche for both amphibians and reptiles

(Du preez & Carruthers). The Riverine systems provide a permanent flow of water in a natural channel, which forms a micro-habitat for various amphibians (**Table 2**).

The grassland is a suitable habitat for the Striped Harlequin Snake (*Homoroselaps dorsalis*) and Coppery Grass Lizard (*Chaemaesaura aenea*). The Striped Harlequin Snake can be found in old termite mounds and under rocks (Marais 2004), both of which are present in the grassland habitat unit. Most records of this snake are subterranean (Marais 2004). The Coppery Grass Lizard is restricted to the grassland biome and normally occurs along grassy slopes along the eastern escarpment and in the Highveld.

7.3.2 Expected and observed Herpetofauna species

Table 2: **Amphibian** species observed and/or expected to occur.

	Scientific Name	**Common Name**	**Red List Category**	**Occurrence Probability**
1.	*Amietia fuscigula*	Cape River Frog	Least Concern	3
2.	*Amietia poyntoni*	Poynton's River Frog	Not evaluated	3
3.	*Amietia quecketti*	Queckett's River Frog	Least Concern	4
4.	*Cacosternum boettgeri*	Common Caco	Least Concern	4
5.	*Kassina senegalensis*	Bubbling Kassina	Least Concern	4
6.	*Phrynobatrachus natalensis*	Snoring Puddle Frog	Least Concern	3
7.	*Phrynomantis bifasciatus*	Banded Rubber Frog	Least Concern	3
8.	*Schismaderma carens*	Red Toad	Least Concern	4
9.	*Sclerophrys garmani*	Olive Toad	Least Concern	3
10.	*Sclerophrys gutturalis*	Guttural Toad	Least Concern	4
11.	*Strongylopus fasciatus*	Striped Stream Frog	Least Concern	3
12.	*Tomopterna cryptotis*	Tremelo Sand Frog	Least Concern	3
13.	*Tomopterna natalensis*	Natal Sand Frog	Least Concern	3
14.	*Xenopus laevis*	Common Platanna	Least Concern	4

*The occurrence probability of the amphibian species listed above are indicated as follows:
Not likely to occur - 1, Low occurrence probability - 2, Medium occurrence probability - 3, High occurrence probability – 4, Confirmed occurrence – 5.

Table 3: **Reptile** species observed and/or expected to occur.

	Scientific Name	**Common Name**	**Red List Category**	**Occurrence Probability**
1.	*Afrotyphlops bibronii*	Bibron's Blind Snake	Least Concern	3
2.	*Aparallactus capensis*	Black-headed Centipede-eater	Least Concern	3
3.	*Bitis arietans arietans*	Puff Adder	Least Concern	3
4.	*Boaedon capensis*	Brown House Snake	Least Concern	4
5.	*Causus rhombeatus*	Rhombic Night Adder	Least Concern	3
6.	*Chamaeleo dilepis dilepis*	Common Flap-neck Chameleon	Least Concern	2
7.	*Chamaesaura aenea*	Coppery Grass Lizard	Near Threatened	3
8.	*Cordylus jonesii*	Jones' Girdled Lizard	Least Concern	3

9.	*Cordylus vittifer*	Common Girdled Lizard	Least Concern	3
10.	*Crotaphopeltis hotamboeia*	Red-lipped Snake	Least Concern	4
11.	*Dasypeltis scabra*	Rhombic Egg-eater	Least Concern	4
12.	*Dispholidus typus typus*	Boomslang	Least Concern	3
13.	*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard	Least Concern	3
14.	*Hemachatus haemachatus*	Rinkhals	Least Concern	4
15.	*Hemidactylus mabouia*	Common Tropical House Gecko	Least Concern	4
16.	*Homoroselaps dorsalis*	Striped Harlequin Snake	Near Threatened	3
17.	*Ichnotropis capensis*	Ornate Rough-scaled Lizard	Least Concern	3
18.	*Lamprophis aurora*	Aurora House Snake	Least Concern	4
19.	*Lycodonomorphus rufulus*	Brown Water Snake	Least Concern	4
20.	*Lycophidion capense capense*	Cape Wolf Snake	Least Concern	4
21.	*Lygodactylus capensis capensis*	Common Dwarf Gecko	Least Concern	4
22.	*Naja annulifera*	Snouted Cobra	Least Concern	3
23.	*Naja mossambica*	Mozambique Spitting Cobra	Least Concern	3
24.	*Pachydactylus affinis*	Transvaal Gecko	Least Concern	4
25.	*Pachydactylus capensis*	Cape Gecko	Least Concern	3
26.	*Pelomedusa subrufa*	Central Marsh Terrapin	Least Concern	4
27.	*Philothamnus semivariegatus*	Spotted Bush Snake	Least Concern	3
28.	*Psammophis brevirostris*	Short-snouted Grass Snake	Least Concern	4
29.	*Psammophis crucifer*	Cross-marked Grass Snake	Least Concern	3
30.	*Psammophylax rhombeatus rhombeatus*	Spotted Grass Snake	Least Concern	4
31.	*Pseudaspis cana*	Mole Snake	Least Concern	4
32.	*Stigmochelys pardalis*	Leopard Tortoise	Least Concern	3
33.	*Trachylepis capensis*	Cape Skink	Least Concern	4
34.	*Trachylepis punctatissima*	Speckled Rock Skink	Least Concern	4
35.	*Trachylepis varia*	Variable Skink	Least Concern	4
36.	*Varanus albigularis albigularis*	Rock Monitor	Least Concern	4
37.	*Varanus niloticus*	Water Monitor	Least Concern	4

*The occurrence probability of the reptile species listed above are indicated as follows:
Not likely to occur - 1, Low occurrence probability - 2, Medium occurrence probability - 3, High occurrence probability – 4, Confirmed occurrence – 5.

7.3.3 Threatened and Red Listed Herpetofauna species

On account of the habitat present within the study area as well as the individual habitat preferences of the species listed in table 2 and 3, two near threatened reptiles species namely; Striped Harlequin Snake and Coppery Grass Lizard, are likely to occur within the study area. Although neither one of the aforementioned near threatened species was confirmed to occur their probable occurrence based on habitat availability and their individual habitat preferences are judged to be moderately likely.

7.4 Findings

Suitable habitat for both the Striped Harlequin Snake (*Homoroselaps dorsalis)* and Coppery Grass Lizard (*Chaemaesaura aenea*) were identified within the study site. The occurrence probability of both these species was deemed to be moderate on account of habitat availability connectivity with homogeneous habitats as well as their individual habitat preferences. Six species of amphibians and 19 species of reptiles were given a high occurrence probability within the study area.

8. INVERTEBRATE HABITAT ASSESSMENT

8.1 Methods

Surveys were conducted on the 18th, 19th and 25th of February, the 2nd of March and the 22nd of April 2016, which consisted of random walked transects. The dominant invertebrate species and possible suitable habitats for Red Data invertebrate species were noted and sampled if necessary. Habitat characteristics for species present were derived from a survey and descriptions given in the field guide by Picker *et al.* (2004). The IUCN Red Listed Species were consulted online for conservation status of Red List species (IUCN 2015). All insects were identified according to field guides such as Picker *et al*. (2004). IUCN Red Listed Butterflies were identified according to Henning *et al.* (2009) and Mecenero *et al*. (2013).

A desktop study was done to identify suitable habitats for the Red List invertebrate species known to occur in the QDS 2528CD. The Animal Demography Unit: Virtual Museum (http://vmus.adu.org.za/) was consulted to verify the record of occurrence of invertebrate species recorded within the QDS 2528CD.

The majority of invertebrate species are nocturnal, poikilothermic secretive and seasonal, which makes it difficult to observe them during field surveys. In this case the presence of invertebrate species was examined on habitat preferred by selected species and respective documented ranges.

8.2 Specific Requirements

During the field survey attention was paid to note any signs of potential occurrence of threatened species as well as species associated with ridges.

These species include:

Roodepoort Copper Butterfly (*Aloeides dentatis* subsp. *dentatis*), Heidelberg Copper Butterfly (*Chrysoritis aureus*), Highveld Blue (*Lepidochrysops praeterita*), Mijburgh's Blue (*Orachrysops mijburghi*), Lilac tip (*Colotis celimene amina*), Grassland Blue (*Lepidochrysops procera*), Marsh Sylph (*Metisella meninx*), Hilltop hopper (*Platylesches dolomitica*), Stobbia's Fruit Chafer Beetle (*Ichnestoma stobbiai*), (*Trichocephala brincki*), (*Brachionopus pretoriae*), (*Hadogenes gracilis*), and (*Hadogenes gunningi*)which have "uncertain" IUCN Red Listed status.

8.3 Results

8.3.1 Invertebrate habitats identified

The major habitats of concern in this area were grassland and wetland habitats. The reason for this is because biodiversity in grasslands is only second to the Fynbos (WWF 2016). Wetlands are protected under the RAMSAR convention (http://www.ramsar.org/) and provide the habitat for many hemimetabolous insects to complete their life-cycles as they are amphibious and rely on water for breeding.

8.3.2 Expected Invertebrate species

Table 4: **Invertebrate** species expected to occur

	Scientific Name	**Common name**	**Red List Category**	**Occurrence Probability**
1.	*Acraea aglaonice*	Clear-spotted Acraea	Least Concern	1
2.	*Acraea barberi*	Barber's Acraea	Least Concern	1
3.	*Acraea horta*	Garden Acraea	Least Concern	4
4.	*Acraea neobule neobule*	Wandering donkey acraea	Least Concern	3
5.	*Actizera lucida*	Rayed blue	Least Concern	3
6.	*Africallagma*	African bluets	Not listed	3
7.	*Africallagma glaucum*	Swamp Bluet	Not listed	3
8.	*Africallagma sapphirinum*	Sapphire Bluet	Not listed	3
9.	*Agriocnemis*	Wisps	Not listed	3
10.	*Agriocnemis falcifera*	White-masked Wisp	Not listed	3
11.	*Aloeides taikosama*	Dusky copper	Least Concern	3
12.	*Anax speratus*	(Eastern) Orange Emperor	Not listed	3
13.	*Anthene amarah amarah*	Black striped hairtail	Least Concern	3
14.	*Anthene definita definita*	Common hairtail	Least Concern	3
15.	*Axiocerses amanga amanga*	Bush scarlet	Least Concern	3
16.	*Axiocerses tjoane tjoane*	Eastern scarlet	Least Concern	5
17.	*Azanus jesous*	Topaz babul blue	Least Concern	3
18.	*Azanus moriqua*	Black-bordered babul blue	Least Concern	3
19.	*Azanus natalensis*	Natal babul blue	Least Concern	3
20.	*Azanus ubaldus*	Velvet-spotted babul blue	Least Concern	3

21.	*Belenois aurota*	Brown-veined white	Least Concern	4
22.	*Belenois creona severina*	African common white	Least Concern	5
23.	*Belenois zochalia zochalia*	Forest white	Least Concern	1
24.	*Brachionopus*		Not listed	3
25.	*Byblia ilithyia*	Spotted joker	Least Concern	3
26.	*Cacyreus lingeus*	Bush bronze	Least Concern	3
27.	*Cacyreus marshalli*	Common geranium bronze	Least Concern	3
28.	*Cacyreus virilis*	Mocker bronze	Least Concern	3
29.	*Capys disjunctus*	Russet protea	Least Concern	3
30.	*Catacroptera cloanthe cloanthe*	Pirate	Least Concern	3
31.	*Catopsilia florella*	African migrant	Least Concern	3
32.	*Ceratogomphus pictus*	Common Thorntail	Not listed	3
33.	*Ceryx fulvescens fulvescens*		Not Evaluated	3
34.	*Charaxes brutus natalensis*	White-barred charaxes	Least Concern	3
35.	*Charaxes jasius saturnus*	Foxy charaxes	Least Concern	3
36.	*Chiasmia kirbyi kirbyi*		Not Assessed	3
37.	*Chilades trochylus*	Grass jewel	Least Concern	3
38.	*Coeliades forestan forestan*	Striped policeman	Least Concern	3
39.	*Colias electo electo*	African clouded yellow	Least Concern	3
40.	*Colotis*		Not listed	3
41.	*Colotis antevippe gavisa*	Red tip	Least Concern	3
42.	*Colotis euippe omphale*	Smoky orange tip	Least Concern	3
43.	*Colotis evenina evenina*	Orange tip	Least Concern	3
44.	*Conolophia conscitaria conscitaria*		Not Assessed	3
45.	*Crocothemis erythraea*	Broad Scarlet	Not listed	3
46.	*Crocothemis sanguinolenta*	Little Scarlet	Not listed	3
47.	*Crudaria leroma*	Silver spotted grey	Least Concern	5
48.	*Cupidopsis cissus cissus*	Common meadow blue	Least Concern	3
49.	*Cyligramma latona latona*		Not Evaluated	3
50.	*Danaus chrysippus orientis*	African monarch, Plain tiger	Least Concern	4
51.	*Diaphania indica indica*		Not Evaluated	3
52.	*Diplacodes luminans*	Barbet Percher	Not listed	5
53.	*Dysgonia torrida torrida*		Not Evaluated	5
54.	*Eicochrysops messapus mahallakoaena*	Cupreous blue	Least Concern	5
55.	*Elattoneura glauca*	Common Threadtail	Not listed	3
56.	*Eretis*		Not listed	5
57.	*Euchrysops dolorosa*	Sabie smoky blue	Least Concern	3
58.	*Euchrysops malathana*	Common smoky blue	Least Concern	3
59.	*Eurema brigitta brigitta*	Broad-bordered grass yellow	Least Concern	3
60.	*Gegenes niso niso*	Common hottentot	Least Concern	3
61.	*Gegenes pumilio gambica*	Dark hottentot	Least Concern	3
62.	*Grammodes stolida stolida*		Not Evaluated	3
63.	*Hadogenes gunningi*		Not listed	3
64.	*Hamanumida daedalus*	Guinea-fowl butterfly	Least Concern	5
65.	*Harpactira hamiltoni*		Not listed	3
66.	*Heteropsis perspicua perspicua*	Eyed bush brown	Least Concern	3
67.	*Hippotion celerio celerio*		Not Evaluated	3
68.	*Hypolimnas misippus*	Common diadem	Least Concern	3
69.	*Hypolycaena philippus philippus*	Purplebrown hairstreak	Least Concern	3
70.	*Ischnura senegalensis*	Tropical Bluetail	Not listed	3
71.	*Junonia hierta cebrene*	Yellow pansy	Least Concern	4
72.	*Junonia oenone oenone*	Blue pansy	Least Concern	4
73.	*Junonia orithya*	Eyed pansy	Least Concern	3

	madagascariensis			
74.	*Kedestes nerva nerva*	Scarce ranger	Least Concern	3
75.	*Kedestes wallengrenii wallengrenii*	Wallengren's ranger	Least Concern	3
76.	*Kedestesepenula*	Chequered ranger	Least Concern	5
77.	*Lampides boeticus*	Pea blue	Least Concern	3
78.	*Leptomyrina henningi henningi*	Henning's black-eye	Least Concern	3
79.	*Leptotes*		Not listed	3
80.	*Leptotes pirithous pirithous*	Common zebra blue	Least Concern	3
81.	*Lestes pallidus*	Pallid Spreadwing	Not listed	3
82.	*Lestes plagiatus*	Highland Spreadwing	Not listed	3
83.	*Lestes virgatus*	Smoky Spreadwing	Not listed	3
84.	*Ligdia batesii batesii*		Not Assessed	3
85.	*Metisella meninx*	Marsh sylph	Least Concern	2
86.	*Metisella willemi*	Netted sylph	Least Concern	3
87.	*Morasa modesta modesta*		Not Evaluated	3
88.	*Mylothris agathina agathina*	Common dotted border	Least Concern	3
89.	*Mylothris rueppellii haemus*	Twin dotted border	Least Concern	3
90.	*Myrina silenus ficedula*	Common fig tree blue	Least Concern	5
91.	*Myrmeleon obscurus*			3
92.	*Nephele comma comma*		Not Evaluated	3
93.	*Nesciothemis farinosa*	Eastern Blacktail	Not listed	5
94.	*Opistophthalmus pugnax*		Not listed	4
95.	*Orthetrum*		Not listed	5
96.	*Orthetrum abbotti*	Little Skimmer	Not listed	5
97.	*Orthetrum caffrum*	Two-striped Skimmer	Not listed	3
98.	*Orthetrum chrysostigma*	Epaulet Skimmer	Not listed	3
99.	*Orthetrum hintzi*	Dark-shouldered Skimmer	Not listed	3
100.	*Orthetrum julia*	Julia Skimmer	Not listed	3
101.	*Palpopleura jucunda*	Yellow-veined Widow	Not listed	3
102.	*Pantala flavescens*	Wandering Glider	Not listed	3
103.	*Papilio demodocus demodocus*	Citrus swallowtail	Least Concern	4
104..	*Paragomphus cognatus*	Rock Hooktail	Not listed	3
105.	*Parnara monasi*	Water watchman	Least Concern	3
106.	*Phalanta phalantha aethiopica*	African leopard	Least Concern	3
107.	*Pinheyschna subpupillata*	Stream Hawker	Not listed	3
108.	*Platycypha*	dancing jewels	Not listed	3
109.	*Platycypha caligata*	Dancing Jewel	Not listed	3
110.	*Platylesches ayresii*	Peppered hopper	Least Concern	3
111.	*Platylesches neba*	Flower-girl hopper	Least Concern	3
112.	*Pontia helice helice*	Common meadow white	Least Concern	5
113.	*Precis archesia archesia*	Garden commodore	Least Concern	3
114.	*Precis ceryne ceryne*	Marsh commodore	Least Concern	3
115.	*Proctarrelabis sp.*			3
116.	*Pseudagrion*		Not listed	5
117.	*Pseudagrion kersteni*	Powder-faced Sprite	Not listed	3
118.	*Pseudagrion massaicum*	Masai Sprite	Not listed	5
119.	*Pseudagrion salisburyense*	Slate Sprite	Not listed	3
120.	*Pseudagrion spernatum*	Upland Sprite	Not listed	3
121.	*Pseudolychas ochraceus*		Not listed	3
122.	*Sarangesa phidyle*	Small elfin	Least Concern	3
123.	*Sphingomorpha chlorea chlorea*		Not Evaluated	3
124.	*Spialia*		Not listed	3
125.	*Spialia colotes transvaaliae*	Bushveld sandman	Least Concern	3
126.	*Spialia diomus ferax*	Common sandman	Least Concern	4
127.	*Spialia spio*	Mountain sandman	Least Concern	3

128.	*Sympetrum fonscolombii*	Red-veined Darter or Nomad	Not listed	3
129.	*Syndromodes cellulata cellulata*		Not Assessed	3
130.	*Tarucus sybaris sybaris*	Dotted blue	Least Concern	3
131.	*Telchinia rahira rahira*	Marsh acraea	Least Concern	3
132.	*Telchinia serena*	Dancing acraea	Least Concern	3
133.	*Trichoplusia orichalcea orichalcea*		Not Evaluated	3
134.	*Trithemis*		Not listed	5
135.	*Trithemis annulata*	Violet Dropwing	Not listed	3
136.	*Trithemis arteriosa*	Red-veined Dropwing	Not listed	4
137	*Trithemis dorsalis*	Highland Dropwing	Not listed	3
138	*Trithemis furva*	Navy Dropwing	Not listed	3
139	*Trithemis kirbyi*	Orange-winged Dropwing	Not listed	4
140	*Trithemis stictica*	Jaunty Dropwing	Not listed	3
141	*Tuxentius melaena melaena*	Black pie	Least Concern	3
142	*Uranothauma nubifer nubifer*	Black heart	Least Concern	3
143	*Uroplectes triangulifer*		Not listed	3
144	*Utetheisa pulchella pulchella*		Not Evaluated	3
145	*Vanessa cardui*	Painted lady	Least Concern	4
146	*Virachola antalus*	Brown playboy	Least Concern	3
147	*Ypthima asterope asterope*	African ringlet	Least Concern	3
148	*Ypthima impura paupera*	Impure ringlet	Least Concern	3
149	*Zintha hintza hintza*	Hintza pierrot	Least Concern	3
150	*Zizeeria knysna knysna*	African grass blue	Least Concern	3
151	*Zizula hylax*	Tiny grass blue	Least Concern	3
152	*Zophopetes dysmephila*	Palm-tree night-fighter	Least Concern	3
153		Unidentified HESPERIIDAE	Not listed	3

The occurrence probability of the invertebrate species listed above is indicated as follows:
Not likely to occur - 1, Low occurrence probability - 2, Medium occurrence probability - 3, High occurrence probability – 4,

8.3.3 Threatened and Red Listed Invertebrate species

No Red Data invertebrate species were recorded on or near the study area. An assessment of invertebrate species of conservation concern should take into account the status of the following butterflies: Roodepoort Copper *Aloeides dentatis dentatis* (Endangered), Golden Opal *Chysoritis aureus* (Endangered), Highveld Blue *Lepidochrysops praeterita* (Endangered) and Mijburgh's Blue *Orachrysops mijburghi* (Endangered), Lilac Tip *Colotis celimene amina* (Rare Low Density), Grassland Blue *Lepidochrysops procera* (Rare Habitat Specialist) , Marsh Sylph *Metisella meninx* (Rare Habitat Specialist) and Hilltop Hopper *Platylesches dolomitica* (Rare Low Density). Beetles of conservation priority are *Ichnestoma stobbai* (previously uncertain or Endangered and currently not assessed) and *Trichocephala brincki* (previously uncertain but presently not assessed). Mygalomorph spiders include *Brachionopus pretoriae* (previously uncertain but presently not assessed). Scorpions include *Hadogenes gracilis* and *H. gunningi* (both previously uncertain and presently unassessed).

8.4 Findings

In the absence of Red listed species, the presence of three wetland species alone provides immediate evidence for the existence of the wetland and its necessary preservation. These are all hemimetabolous species which are tied to the habitat for breeding and territorial reasons. Any developmental changes to this habitat would be detrimental to their existence. These wetland species are important as putatative flagship or indicator species. The small scarlet (*Crocothemis sanguinolenta*) is easily confused with *Crocothemis erythraea* and until the possible breeding differences (alluded to by abdominal differences) between the two have been established, development of these systems should be carefully monitored. However no sensitive invertebrate species were recorded within the study area. Species such as *Crocothemis* which are dependent on wetland habitats are a conservation priority.

9. OVERALL FINDINGS AND IMPLICATIONS

Large sections of the study area remain in a near natural state with good connectivity with homogeneous habitats in the surrounding area. The majority of the surrounding land use is of an agricultural nature witch still provide good foraging and breeding opportunities for a large number of faunal species. Suitable habitat for the Near Threatened Striped Harlequin Snake and Coppery Grass lizard were identified within the grassland and ridge habitat units. Four Near Threatened mammal species, of which two were confirmed to occur and the remaining two highly likely to occur, were judge to be resident within the grassland, wetland and riverine habitat unit. Suitable bat roosts were observed in the Rocky Ridge and Woodland habitats, thus it can be expected that some of the threatened bat species are resident within the study area on account of the good connectivity and minimal disturbances of the Ridge habitat unit.

The drainage line and riverine habitat have the potential to support sensitive species and/or species with conservation concerns (Vlei Rats and Otters). Both of these species are believed to occur at present on account of the habitat present on the study area. Six amphibian s species and 19 reptile species were given a high probability of occurring within the study area (**Tables 2 & 3**). The presence of three wetland invertebrate species provides immediate evidence for the existence of the wetland and its necessary preservation. Both the grassland, wetland, ridge, and riverine habitat provide sustainable habitat for threatened and near threatened faunal species and as such these habitat units provide important ecological functions in terms of connectivity as well as the sustainable well-being of sensitive fauna.

10. LIMITATIONS

The bulk of the data used to conclude the distribution of Red Data species were sourced by making use of the Animal Demography Unit: Virtual Museum data basis. Any limitations in the above mentioned data basis will in effect have implications on the findings and conclusion of this assessment. Furthermore this faunal assessment was conducted during April; hence the survey was done outside the main reproductive period of the local faunal species. Moreover, a lot of the hibernating fauna began with their hibernation period. Limited time to conduct the survey could potentially result in not recording all species within the study are

11. RECOMMENDATIONS

- An appropriate management authority that must be contractually bound to implement the EMP and ROD during the constructional and operational phase of the development should be identified and informed of their responsibilities in terms of the EMP and ROD.
- Prior to any activities commencing on site, all construction staff should be briefed in an environmental induction regarding the environmental status and requirements of the site. This should include providing general guidelines for minimizing environmental damage during construction, as well as education with regards to basic environmental ethics, such as the prevention of littering, lighting of fires, etc.
- Induction should be done for all civil contractors and for each building contractor prior to them commencing on site.
- Construction should be restricted to areas deemed to have a low to medium ecological sensitivity (Please refer to **Figure 10**).
- Areas where construction is to take place should be clearly demarcated and fenced off, all areas outside that of the defined works should be deemed no-go areas.
- All construction activities must be restricted to the demarcated areas to ensure that no further disturbance into the surrounding vegetation or habitat takes place.
- It is recommended that prior to the commencement of construction activities' initial clearing of all alien vegetation should take place.
- No vehicles should be allowed to move in or through the drainage line. This will cause destruction of faunal habitat and will leave notable scares on site.
- The contractor must ensure that no faunal species are trapped, killed or in any way disturbed during the constructional phase.
- It is recommended that all concrete and cement works be restricted to areas of low ecological sensitivity and defined on site and clearly demarcated. Cement powder has a

high alkalinity pH rating, which can contaminate and affect both soil and water pH dramatically. A shift in the pH can have serious consequences on the functioning of soil, vegetation and fauna.

- To ensure minimal disturbance of faunal habitat it is recommended that construction should take place during winter, outside the reproductive season of the species present on site.
- Construction, vegetation clearing and top soil clearing should commence from a predetermined location and gradually commence to ensure that fauna present on the site have enough time to relocate.
- When construction is completed, disturbed areas should be rehabilitated using vegetation cleared prior to construction to ensure that the habitat stays intact and that faunal species present on the site before construction took place, return to the area.
- All constructional activities must comply with the guidelines, requirements and objectives of the Ridges Policy and Guidelines of Gauteng (GRARD 2006).

12. CONCLUSION

Due to the sensitive nature of the wetlands, woodland, rocky ridge and riverine areas induction with all the partaking contractors, workers, road engineers and landowners is necessary, in order to make them aware of the areas deemed to be sensitive according to this report and to act accordingly. Development should be restricted to areas deemed to have a low to medium ecological sensitivity (**Figure 10**).

Given the acceptance of the recommendations, the proposed development will result in the destruction and/or loss of important or ecologically sensitive habitat units from a faunal perspective. A re-alignment of the proposed PWV17 is advised.

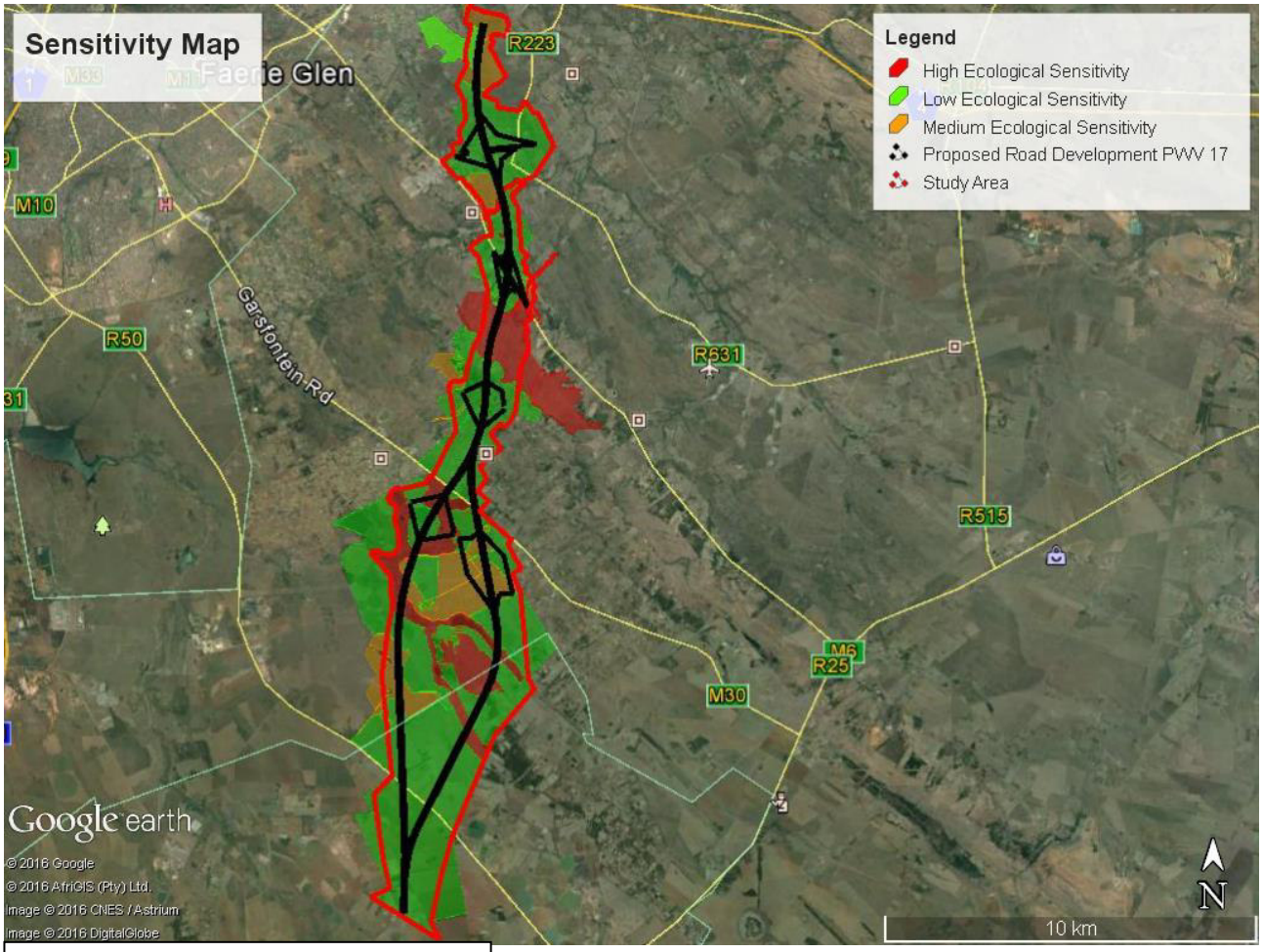

Figure 10: Faunal Sensitivity Map

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Annexure A:

The occurrence of Juliana's golden mole (*Neamblysomus julianae*) along the proposed PWV17 Road on the Bronberg Mountain (Tierpoortrand).

By

I.L. Rautenbach (Pr.Sci.Nat. # 400300/05, T.H.E.D., Ph.D.)

March 2016

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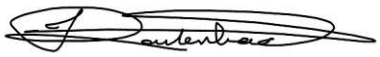
FIGURES:

Declaration of Professional Standing and Independence:

I, Ignatius Lourens Rautenbach (421201 5012 08 8) declare that I:

- hold a Ph.D. in the biological sciences, which allowed registration by SACNASP (SA Council for National Scientific Professions) as a Professional Zoologist and sanction me to function independently as a specialist scientific consultant
- declare that as per prerequisites of the Natural Scientific Professions Act No. 27 of 2003 this project was my work from inception and reflects exclusively my observations and unbiased scientific interpretations, and executed to the best of my ability
- abide by the Code of Ethics of the SACNASP
- am committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas I appreciate opportunities to learn through constructive criticism and debate, I reserve the right to form and hold my own opinions within the constraints of my training and experience, and therefore will not submit willingly to the interests of other parties or change my statements to appease them
- am subcontracted as a specialist consultant by Bokamoso Landscape Architects for the project entitled "The occurrence of Juliana's golden mole (*Neamblysomus julianae*) along the proposed PWV17 Road on the Bronberg Mountain (Tierpoortrand)" as described in this report
- have no financial interest in the proposed development other than remuneration for the work performed
- do not have, and will not have in the future, any vested or conflicting interests in the proposed development
- undertake to disclose to Galago Environmental CC and its client(s) as well as to the competent authority any material information that may have the potential to influence any decisions by the competent authority, as required in terms of the Environmental Impact Assessment Regulations, 2014
- reserve the right to only transfer my intellectual property contained in this report to the client(s), (party or company that commissioned the work) on full payment of the contract fee. Upon transfer of the intellectual property, I recognise that written consent from the client will be required for me to release any part of this report to third parties.
- In addition, remuneration for services provided by Galago Environmental CC is not subjected to or based on approval of the proposed project by the relevant authorities responsible for authorising this proposed project.



I.L. Rautenbach

ABSTRACT

It is concluded that *Neamblysomus julianae* does not occur along the proposed route for the PWV17 road, or within 500 meters of the route. This is in agreement with findings in the vicinity of the proposed route.
From the narrow perspective of this report, no objections can be raised against the construction of the PWV17 between localities 16 and 17 (Figures 1 and 2) along the route investigated.

1. INTRODUCTION

On behalf of the responsible road agency, this report was commissioned by Bokamoso Landscape Architects and Environmental Consultants. The purpose of the study is to ascertain the presence (or absence) of the Critically Endangered Juliana's golden mole (*Neamblysomus julianae*) along sector 16 – 17 on the northern slope of the Bronberg Mountain (Tierpoortrand) (Figures 1 and 2). Special attention was paid to the qualitative and quantitative habitat conditions for Juliana's golden mole, and if present offer mitigation measures to ameliorate the effect of the suggested development.

This assignment is in accordance with the 2010 EIA Regulations (No. R. 543-546, Department of Environmental Affairs and Tourism, 18 June 2010) emanating from Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

2. RATIONALE

Environmental conservation is no longer the prerogative of vocal left-wing 1960s-style green activist NGOs. Instead it is now universally appreciated that a rapidly-growing and more demanding human population is continuing to place exponential stress on the earth's resources with irredeemable costs to ecosystems. It is also recognized that ecosystems are in fact nature's 'engine room' to manufacture fundamental live-support products for plants, animals and humans. Environmental degradation ranges from mega-problems such as global warming, demand for power, land-use practices to indiscriminate use of household chemicals.

The new conservation awareness is settling at all levels ranging from consumers, school curricula, communities to governments. This new consciousness is typified by vigorous debate and empathy, and sometimes by decisiveness (viz. new legislation).

In South Africa a number of acts and regulations, such as:
The Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996),
The Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983),
The Environmental Conservation Act, 1989 (Act No. 73 of 1989),
The National Environment Management Act, 1998 (Act No. 107 of 1998) as amended in 2010,
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The National Environmental Management: Waste Act [NEM:WA] (Act 59 of 2008),

The National Forests Act, 2006 (Act 84 of 1998 as amended in 2006),
The National Heritage Resources Act, 1999 (Act No. 25 of 1999),
The National Environmental Management: Protected Areas Act (Act 57 0f 2003),
The Mineral and Petroleum Resources Development Act 28 of 2002,
The National Water Act, 1998 (Act No. 36 of 1998), and
The Environmental Impact Assessment Regulations Notice 733 of 2014.

Call developers (and by implication consumers), the scientific community and conservation agencies to task to minimise environmental impact. The conduct of natural scientists is directed by The Natural Scientific Professions Act (Act 27 of 2003). Nowadays a development prerogative is to precede new constructions by a multidisciplinary environmental investigation to assess the conservation costs. This is to ensure that best conservation practices are applied during the planning, construction and operational phases of new developments.

3. BACKGROUND

Golden moles (Chrysochloridae) constitute an ancient mammal family (50-57 million years since divergence) endemic to Sub-Saharan Africa, with a centre of distribution in Southern Africa. All species are insectivorous and fossorial, have a golden sheen on their dense fur, and all have a dependence on soft substrates.

Juliana's golden mole (*Neamblysomus julianae*) is one of the smallest members of this distinct family of fossorial and exclusively insectivorous mammals. In Gauteng it occurs only in the Willows and Shere areas along the slopes and foot of the Bronberg (Bronner et al., 2003; Meester et al., 1986; Skinner and Chimimba, 2005). It is also known from Nylsvlei north of Pretoria and in Pretoriuskop in the Kruger National Park (but there is some doubt whether these populations differ genetically from the Pretoria population at the species level).

N. julianae is categorized as "Critically Endangered" by Friedman and Daly (2004). Apart from being severely restricted in its distributional range, it is in the Pretoria area threatened by high-density urbanization. Most records of occurrence are in sandy pockets amongst rocks along the Bronberg. It would, however, appear that these records does not necessary represent its preferred habitat and that destruction of preferred sandy habitat on the plains by intensive urban development is responsible for limiting its range to the Bronberg *per se* where urbanization is curbed as per the GDARD "Ridges Policy". Sites with suitable sandy substrate have been found on the plains south of the Bronberg foothills where this mole has re-populated a small fallow field. Jackson et al. (2007) correlates golden mole occurrence with soil particle size and comparatively low density.

When appraising the conservation status of an insectivore in an ecosystem (such as golden moles or shrews), it should be borne in mind that insectivores function at the apex of a food chain, and in order to sustain its food source its population numbers must be numerically lower than that of herbivores (viz. rodents). It is thus contended that wherever Juliana's golden mole occur in natural or semi-natural environments, its population density approach natural levels.

Little is known of Juliana's golden mole, and field information is largely anecdotal. Like other golden moles, it 'swims' in soft sand just below the surface while foraging for invertebrate prey by loosening the substrate with the well-developed claws of the phalanges and then lifting the sand with the padded snout and shoulders to form an unstable tunnel. As result its wanderings are characterized by a trail of cracked soil visible on the surface. These trails are particularly noticeable after rains, both since wet sand have a firmer texture and mole activity then appears to be higher. It would appear that this species is mostly solitary, and that during breeding it also constructs deeper tunnels and breeding chambers to maintain young (Jackson et al., 2009). As result of its random subsurface movements it is extremely difficult to trap and relocate individuals. This was never done successfully before.

It should be obvious that the trend to protect suburban properties by means of security walls and partitions, local populations of Juliana's Golden Mole are divided into small unviable units. However, in larger properties with well-maintained gardens in sandy and composted substrate golden moles co-exist well with normal garden practices.

Burrowing abilities of golden moles are, compared to rodent moles, extremely limited. It must be emphasized that the preferred habitat for golden moles (in particular Juliana's golden mole) is loose sand with no or minimal clay content, precluding compaction. Compacted soil of any kind will preclude burrowing and dispersion. Records of occurrences along the Bronberg are mostly in loose light-coloured sand, with some exceptions in red sand (such as Lynwood Office Park).

Monthly observations during the construction of the Lynwood Office Park showed that burrowing activities of Juliana's golden mole are less during winter, and that this decline can be correlated with seasonal soil dehydration and concomitant compaction, and according to Jackson et al. (2009) also ambient temperature. Year-round activity levels on the Lynwood Office site were, however, retained by composting and irrigating the two conservation areas and the dispersal corridor. Jackson et al. (2009) found that *N. julianae* uses thermoregulation to conserve energy, and that good basal cover is conducive to maintaining substrate moisture and optimum temperatures. However, there is no evidence that Juliana's golden mole enter torpor or hibernation during stress periods, such as winters.

Golden moles do, at times, venture above ground. They are sometimes found in barn owl pellets and sometimes caught by pets. Golden mole eyes are rudimentary and overgrown by skin. At best they can thus only distinguish between light and dark, and cannot make a visual decision on dispersal directions when on the surface. Surface wanderings are therefore concluded to be random.

4. SCOPE AND OBJECTIVES OF THE STUDY

- To qualitatively and quantitatively assess the significance of the golden mole habitat components and current general conservation status of the property;
- Report on the presence of absence of Juliana's golden mole (*Neamblysomus julianae*);

5. STUDY AREA

The portion of the proposed PWV17 route (Localities 16 – 17, Figures 1 and 2) under contention traverses Portion 5 (the Brown property demarcated in Figure 1) and the Z418 smallholding (the white property marked in Figure 1) of the Farm Zwavelpoort 373 JR (collectively referred to as the study site). The site is east of Pretoria along the Graham Road (M6) and located on the northern slope of the Tierpoortrant. Tierpoortrand is an easterly extension of the Bronberg Ridge. The PWV17 route will cross the Tierpoortrand through a neck in the mountain range. Spatially the route is defined by GPS coordinates 25°51'09.9"S 28°23'31.2"E and 25°50'50.9"S 28°23'38.4"E.

The name Tierpoortrand is actually a misnomer since the very rocky slope (Figure 3) (of > 5º) is in fact an escarpment with the southern border of the property at the edge of a plain with cultivated fields (the organic dairy demarcated in red in Figure 1), and the northern boundary on the valley floor that is bordered by the nearby Graham Road. Both of the portions of The Farm Zwavelpoort comprising the study site have systematically been developed as conservation areas and are managed as such; introduced game species such as zebra, blue wildebeests blesbok and sprinbok graze the grassy slope and summit.

The study site falls peripherally in the Marikana Thornveld and predominantly in the Andesite Mountain Bushveld vegetation units as defined by Mucina and Rutherford (2006). Both properties are comprehensively enclosed with a game fence consisting of adequate supporting droppers, barbed wire, steel fence strands, fence mesh of ca. 10X5cm, and electrical wiring. Although the game fencing is of a quality that renders game breakouts unlikely, it should be noted that connectivity is seriously inhibited, even for smaller species such as red rock hares and small carnivores.

The conservation status of this site is rated as fairly good. The natural and scenic aesthetics is respected and it is remarkable to evaluate a site with such a low presence of exotic trees and shrubs.

A dam has been constructed at the base of the ridge near the homestead to accumulate water from the drainage lines on the slope.

The adjoining 500 meters of adjacent properties to the west and east are similar in land-use practice, physiognomy and conservation status, although conservation is coincidental rather than a priority. The organic dairy to the south-east has deep red clayey soil whereas the foot of the Tierpoortrand on smallholding Z418 consists of brownish-red soil embedded with rocks and gravel.

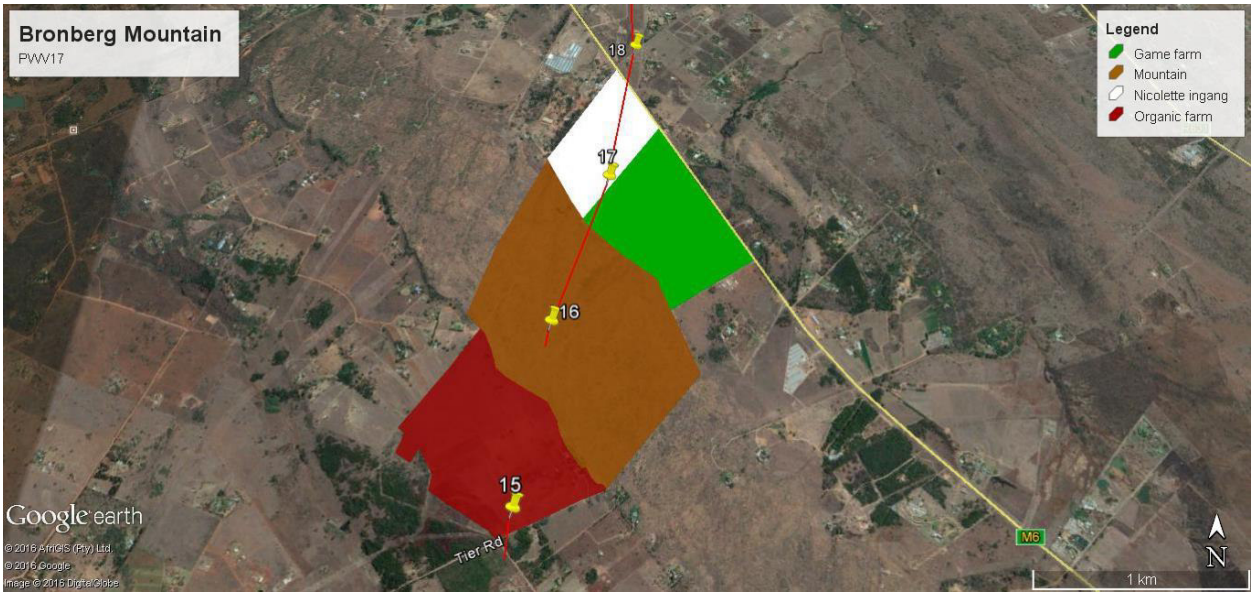

Figure 1: The properties to be affected should the PWV17 follow the proposed route.

Figure 2: The route along the slope of the Tierpoortrand superimposed on a Google-Earth image.

Figure 3: A southerly view over the north-facing slope of the Tierpoortrand. The rocky terrain is truly scenic.

Figure 4: The summit of the slope at the interface between the rocky slope and the grassy plain to the south of the study site. The substrate is entirely unsuitable for golden moles.

Figure 5: The sturdy game fence marking the southern border of the to-be-affected property (Zwavelpoort 373 JR, the Brown demarcated property, Figure 1) consisting of ample droppers, barbed wire, horizontal steel strands, a wire mesh and the isolated electrical wires.

6. METHODS

Site visits were conducted on 4 October 2013 and again on 18 March 2016. During these field studies the presence of characteristic tunnels and ideal habitat for the golden mole was assessed.

The 500 meters of adjoining properties was scanned for the presence of the golden mole and for suitable substrate.

7. RESULTS

The presence of Juliana's golden mole as deduced by their characteristic tunnels was not recorded. Furthermore, nowhere was suitable habitat found. This "Critically Endangered" small insectivorous mole occurs in the loose sandy pockets of the Bronberg to the west of Tierpoortrand. This species is narrowly reliant on soft sand, and its absence on the study site is linked to the absence of such pockets of permanently loose sand. Wherever sandy pockets do occur on the site, they are shallow and very compacted.

8. PROPOSED MITIGATION MEASURES

Nil.

9. CONCLUSIONS

It is concluded that *Neamblysomus julianae* does not occur along the proposed route for the PWV17 road, or within 500 meters of the route. This is in agreement with findings in the vicinity of the proposed route.

From the narrow perspective of this report, no objections can be raised against the construction of the PWV17 between localities 16 and 17 (Figures 1 and 2) along the route investigated.

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ANNEXURE B:

RÉSUMÉ

IGNATIUS LOURENS RAUTENBACH Ph.D., Prof. Nat. Sci.
Independent Environmental Consultant – MAMMALOGY.

Identity Number	421201 5012 00 5
Gender	Male
Date of Birth	1 December 1942
Nationality	South African
Home Languages	Bilingual (English & Afrikaans)
Postal Address	45 Helgaard Street, Kilner Park, Pretoria, RSA 0186. Tel no +27 12 3334112, Cell +27 082 3351288. E-mail naasrauten@mweb.co.za
Former Position	Retired Director: Planning, Northern Flagship Institute
Present Position	Consultant – Specialist, Environmental Impact Assessments (Applied research), Photographing microstock for four agencies
Qualifications	**B.Sc**. (UP), **T.H.E.D** (Pta TTC), **M.Sc.** (UP), **Ph.D**. (Un. Natal)
Professional Honours	1. Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400300/05 2. Fellow of the Photographic Society of South Africa 3. Master photographer at club level 4. Honorary life member of the S.A. Wildlife Management Association.
Notable Research Contribution	In-depth survey of the Mammals of the Transvaal. 1982. 211pp. Ecoplan Monograph 1.
Notable Literary Contribution	Rautenbach, Naas & Annalene Rautenbach. 2008. *Photography for Focused Beginners.* 302pp with 250 images. Green Door Studio, Pretoria.
Formal Courses Attended	Computer Literacy, Project Management, Contract Design, Senior Management

Employment history

May 2001 - Present Self-employed, collaborator with Eco-Agent CC Ecological Consultants as well as Galago Environmental [environmental impact assessments], technical writing, and photography
April 1999 - August 2001 Director: Planning, Northern Flagship Institution
Jan 1991 - April 1999 Executive Director, Transvaal Museum
July 1967 - Dec 1990 Curator (in charge) of the Division of Mammalogy, Transvaal Museum. Promoted to Principal Scientist rank as of June 1985
March - June 1967 Research student at the Mammal Research Institute of the Zoology Department, University of Pretoria
July 1966, Nov l966 - Febr 1967 Member of the Smithsonian Institution's field teams collectively partaking in the 'African Mammal Project'
1966: Part-time research assistant to Prof. J. Meester, University of Pretoria
1962 - 1965 Temporary assistant during University holidays in the Nematology laboratories, Agricultural Technical Services
1991 - 2002 Founder member and non-executive director of the Board of Trustees of
1993 - 2001 Founder member and Trustee of the privatised Museums Pension Fund
1997 - 2001 Non-executive director of the Tswaing Section 21 Company

Professional Achievements

Managed a research institute of 125 members of staff. Solicited numerous grants totalling ≥ R1 000 000. Initiated and overseen building programmes of R30 million at the Transvaal Museum. Conceptualised and managed 12 display programmes.

Research: Author and co-author of 85 scientific publications re mammalogy in peer reviewed subject journals, 18 popular articles, 10 books, and >400 contractual EIA research reports. Extensive field work and laboratory experience in Africa, Europe, USA, Alaska, Brazil and Mexico. B -rated by FRD as scientist of international status 1983 – 1995.

Students: Additional to museum manager duties, **c**o-supervised 5 B.Sc. (Hons.), 2 M.Sc. and 2 Ph.D. students.

Public Recognition:

Public speaking *inter alia* Enrichment Lecturer on board the 6* *SS Silver Wind*, radio talks, TV appearances.

Hobbies

Technical writing, photography, field logistics, biological observations, wood working, cooking, designs.

Personal Evaluation

I am goal-orientated, expecting fellow workers and associates to share this trait. I am an extrovert, sensitive to amicable interpersonal relations. I have a wide interest span ranging from zoological consulting, photography, cooking, sport, news, gardening and out of necessity, DIY. To compensate for my less than perfect memory, I lead a structured and organised life to deal with the detail of a variety of interests. Often to the chagrin to people close to me, I have an inclination to “Think Out of the Box”.

FLORA ASSESSMENT OF PORTIONS ON THE FARMS TWEEFONTEIN 19, HATHERLEY 331, ZWARTKOPPIES 364, MOOIPLAATS 367, TIEGERPOORT 371, ZWAVELPOORT 373, GROOTFONTEIN 394, ELANDSFONTEIN 412 AND TWEEFONTEIN 413

April 2016

Landscape Architects &

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Report Authors: Corné Niemandt and SE van Rooyen

Reviewed by: J.V. van Greuning (*Pr. Sci. Nat*. reg. no. 400168/08)

Specialists

Specialist investigators: Mr. C. Niemandt (M.Sc. Plant Science) and Mr. S.E. van Rooyen (M.Sc. Restoration Ecology and Botany candidate)

Declaration of independence:

The specialist investigators responsible for conducting this particular specialist vegetation study declare that:

• We consider ourselves bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);

• At the time of conducting the study and compiling this report we did not have any interest, hidden or otherwise, in the proposed development, except for financial compensation for work done in a professional capacity;

• Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, we will not be affected in any manner by the outcome of any environmental process of which this report may form a part;

• We declare that there are no circumstances that may compromise our objectivity in performing this specialist investigation. We do not necessarily object to or endorse the proposed development, but aim to present facts, findings and recommendations based on relevant professional experience and scientific data;

• We do not have any influence over decisions made by the governing authorities;

• We have the necessary qualifications and guidance from professional experts (registered Pr. Nat. Sci.) in conducting specialist reports relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;

• This document and all information contained herein is and will remain the intellectual property of Bokamoso Environmental: Specialist Division. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the specialist investigators.

Corné Niemandt S.E. van Rooyen

VERIFICATION STATEMENT

This communication serves to verify that the flora report compiled by Corné Niemandt has been prepared under my supervision, and I have verified the contents thereof.

Declaration of independence: I, Dr. J.V. van Greuning (*Pr. Sci. Nat*. reg. no. 400168/08) declare that I:

- am committed to biodiversity conservation but concomitantly recognise the need for economic development. Whereas I appreciate the opportunity to also learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them.
- abide by the Code of Ethics of the S.A. Council of Natural Scientific Professions
- act as an independent specialist consultant in the field of Botany
- am subcontracted as specialist consultant by Bokamoso Environmental Consultants for the proposed Mixed Use development of the remaining extent of portion 1 of the farm Waterfall 5-IR described in this report
- have no financial interest in the proposed development other than remuneration for work performed
- have or will not have any vested or conflicting interests in the proposed development
- undertake to disclose to Bokamoso Environmental Consultants and its client as well as the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations, 2014.

Dr. J. V. van Greuning

Table of Contents

1. INTRODUCTION

Bokamoso Environmental: Specialist Division was commissioned to conduct a flora assessment for the proposed road known as PWV 17 and its alternative on portions of the Farm Tweefontein 19, Farm Hatherley 331, Farm Zwartkoppies 364, Farm Mooiplaats 367, Farm Tiegerpoort 371, Farm Zwavelpoort 373, Farm Grootfontein 394, Farm Elandsfontein 412 and Farm Tweefontein 413. The objective was to conduct plant species surveys to determine which species occur in the surrounding area site of the proposed road and its alternative. Special attention was given to possible habitats of Red and Orange List plant species that may occur in the surrounding area that might be affected by the proposed development. Furthermore, the ecological status of the vegetation and sensitive habitats of the site were investigated.

2. OBJECTIVES OF THE STUDY

- To assess the habitat component and ecological status of the study area;
- To identify and list the plant species, including alien species, occurring in the study site;
- To identify medicinal plant species;
- To identify Red and Orange List species;
- Make recommendations if any Red and Orange List species are found;
- To indicate the ecological sensitive areas and connectivity of the study site;
- To highlight the impacts on the vegetation of the study site; and
- Provide recommendations to mitigate negative impacts and enhance positive impacts on the vegetation should the proposed road development or its alternative be approved.

3. SCOPE OF STUDY

This report:

- Lists all plant species, including alien species, recorded during the vegetation survey;
- Provides recommendations on Red and Orange List plant species;
- Lists and discuss medicinal plants recorded;
- Comments on ecological sensitive areas and connectivity;
- Comments on impacts affecting the flora of the site;
- Evaluates the conservation importance and significance of the area in and adjacent to the proposed road and its alternative, with special emphasis on the status of threatened species; and

- Provides recommendations to mitigate negative impacts, should the proposed road or its alternative be approved.

4. STUDY AREA

4.1 Regional vegetation

The study site is situated in the quarter degree square (QDS) 2528CD and falls in four vegetation units according to Mucina and Rutherford (2006): Carletonville Dolomite Grassland (Gh 15), Rand Highveld Grassland (Gm 11), Andesite Mountain Bushveld (SVcb 11) and Marikana Thornveld (SVcb 6) (Figure 1). The study site is further located in two threatened ecosystems, both considered Critically Endangered: the Bronberg Mountain Bushveld (BMB) and the Rietvleiriver Highveld Grassland (RRHG; Government Gazette no. 34809, 2011).

Carletonville Dolomite Grassland (Gh 15)

This vegetation unit is considered Least Concern according to the *National list of threatened terrestrial ecosystems for South Africa, 2011* (Government Gazette no. 34809, 2011). The conservation target is 24%, while only a small extent is currently protected and 23% is considered to be transformed, mostly by cultivation (17%), urbanization (4%), forestry (1%) and mining (1%) (Mucina and Rutherford, 2006). This is a species-rich mosaic of plant community types occurring on undulating plains dissected by rocky chert ridges. The Gh 15 is characterized by the presence of the species, *Aristida congesta, Brachiaria serrata, Cynodon dactylon, Digitaria tricholaenoides, Diheteropogon amplectens, Eragrostis chloromelas, Eragrostis racemosa, Heteropogon contortus, Loudetia simplex, Schizachyrium sanguineum, Setaria sphacelata, Themeda triandra*, and a wide variety of herbaceous forbs and other grasses.

Rand Highveld Grassland (Gm 11)

The Gm 11 vegetation unit is regarded as Vulnerable according to the *National list of threatened terrestrial ecosystems for South Africa, 2011* (Government Gazette no. 34809, 2011). Although 60% of this vegetation unit remains as natural area, only approximately 1% of the original area is protected (Mucina and Rutherford, 2006). Five endemic plant species are known to occur in this vegetation unit (Mucina and Rutherford, 2006; Government Gazette no. 34809, 2011). The landscape is described as highly variable with extensive sloping plains and a series of ridges slightly elevated over undulating surrounding plains. The vegetation is species-rich, wiry, sour grassland

alternating with low, sour shrubland on rocky outcrops and steeper slopes. The most common grasses on the plains are *Themeda triandra, Eragrostis* spp*., Heteropogon contortus* and *Elionurus muticus*. High diversity of herbs, many of which belong to the *Asteraceae*, is also a typical feature. Rockyhills and ridges carry sparse (savannoid) woodlands with *Protea caffra* subsp. *caffra, P. welwitschii, Senegalia caffra* and *Celtis africana*, accompanied by a rich suite of shrubs among which the genus *Searsia* (especially *S. magalismonata*) is most prominent (Mucina and Rutherford, 2006).

Andesite Mountain Bushveld (SVcb 11)

This vegetation unit is considered Least Threatened according to Mucina and Rutherford (2006). Although the conservation target for this vegetation type is 24%, only about 7% is statutorily conserved, mainly in the Suikerbosrand Nature Reserve and Magaliesberg area. Approximately 15% of SVcb 11 is already transformed by cultivation and urban development (Mucina and Rutherford, 2006). According to Mucina and Rutherford (2006), the following species are listed as important taxa: *Acacia caffra, Acacia karroo, Celtis africana, Protea caffra, Zanthoxylum capense and Ziziphus mucronata* (Trees), *Asparagus laricinus, Euclea crispa subsp. crispa, Rhus pyroides, Diospyros lycioides, Gymnosporia polyacantha, Lippia javanica and Rhamnus prinoides, Asparagus suaveolens, Rhus rigida, Teucrium trifidum, Isoglossa grantii and Rhoicissus tridentate* (Shrubs), *Eragrostis curvula, Hyparrhenia hirta, Setaria sphacelata, Themeda triandra, Cymbopogon pospischilii, Digitaria eriantha, Elionurus muticus, Eragrostis racemosa, Eragrostis superba* and *Panicum maximum* (Grasses) and *Commelina africana, Vernonia galpinii, Hillierdiella oligocephala* and *Aloe greatheadii* var. *davyana* (Herbs).

Marikana Thornveld (SVcb 6)

The SVcb 6 vegetation unit is regarded as Vulnerable (Government Gazette no. 34809, 2011). Although 55% of this vegetation unit remains as natural area, less than 1% of the original area is protected (Mucina and Rutherford, 2006; Government Gazette no. 34809, 2011). It is described as open *Vachellia karroo* woodland, occurring in valleys and slightly undulating plains, and some lowland hills. Shrubs are denser along drainage lines, on termitaria and rocky outcrops or in other habitat protected from fire. This vegetation unit is considerably impacted, with 48% transformed, mainly due to cultivated and urban or built-up areas. In the east of Pretoria (in the study area), industrial development is a great threat of land transformation. Erosion is very low to moderate. Alien invasive plant species is found localised in high densities, especially along the drainage lines (Mucina and Rutherford, 2006).

Bronberg Mountain Bushveld (GP 3)

The GP 3, which is part of the SVcb 11 vegetation unit, is regarded as Critically Endangered (National Gazette no. 34809, 2011). Approximately 91% of the ecosystem is still natural; however, only 1% is protected (National Gazette no. 34809, 2011). Nineteen threatened or endemic plant and animal species occur in this unit (Government Gazette no. 34809, 2011).

Rietvleiriver Highveld Grassland (GP 7)

The GP 7, which is part of the Gh 15 and Gm 11, is regarded as Critically Endangered (Government Gazette no. 34809, 2011). Approximately 85% of the ecosystem is still natural while 11% is protected (National Gazette no. 34809, 2011). Twenty-five threatened or endemic plant and animal species occur in this unit (Government Gazette no. 34809, 2011).

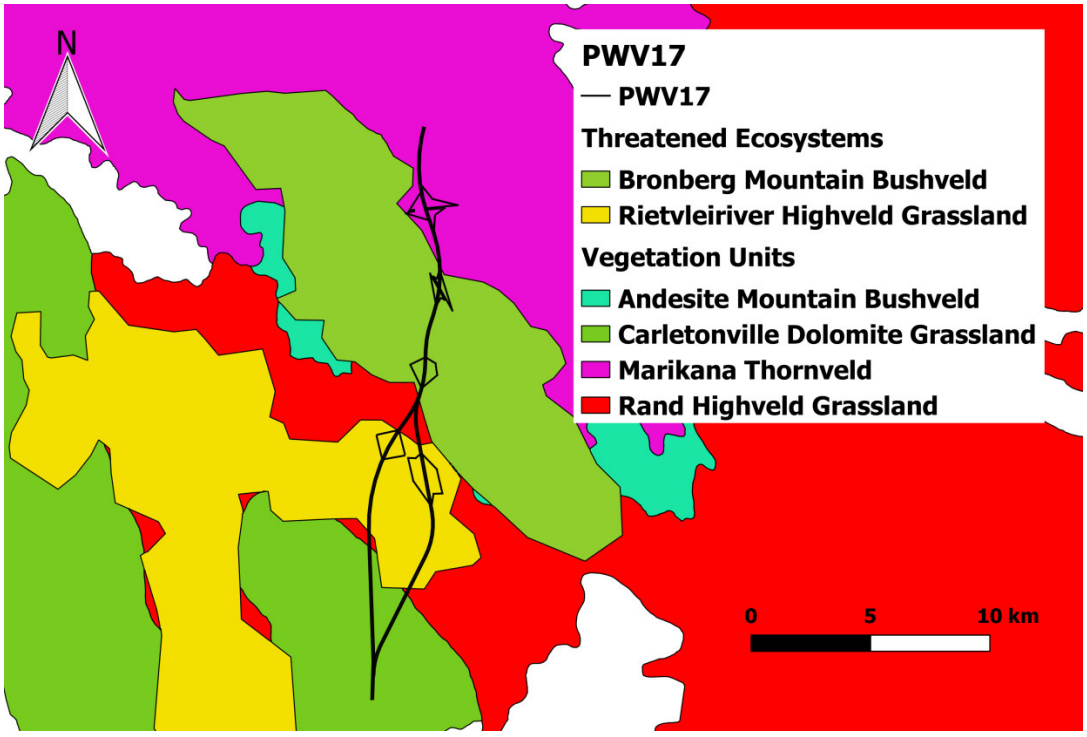

Figure 1 Vegetation units (Mucina and Rutherford, 2006) and threatened ecosystems (National Gazette no. 34809, 2011).

4.2 The study site

The proposed road PWV 17 and its alternative are situated between the R25 in the South, close to the town Bapsfontein and the N4 highway to the North, next to Silver Lakes Estate (**Figure 2**). The aerial map indicates the 1 km intervals for the proposed road and its alternative starting from south to north (**Figure 3**). The proposed road alignment crosses several existing roads including the R50

Delmas Road, the M30 Garsfontein Road, M6 Graham Road and the R631 Boschkop Road. The proposed road and its alternative crosses several land uses, including agriculture, natural vegetation, residential areas etc.

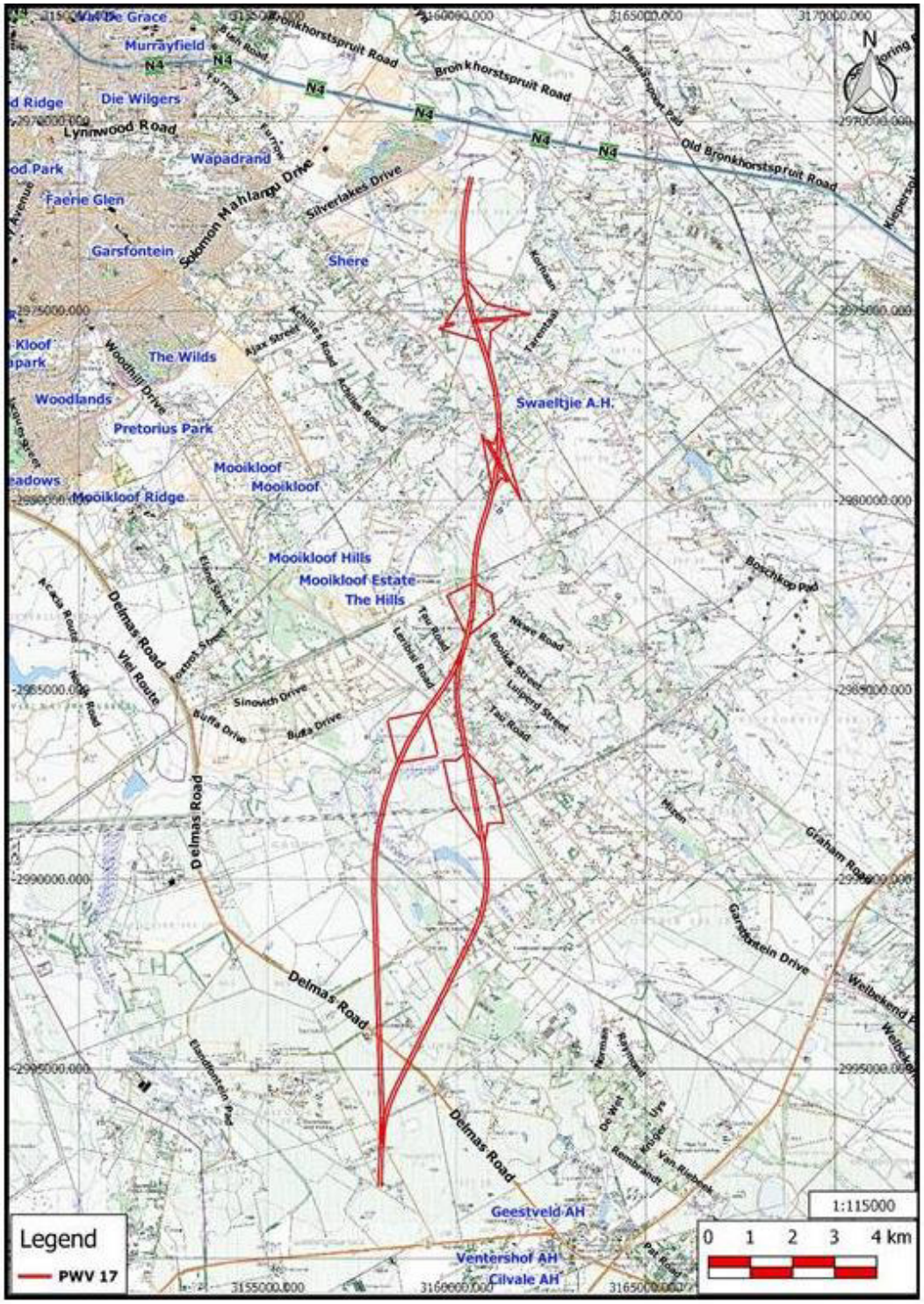

Figure 1 Aerial map to indicate the locality of the study site.

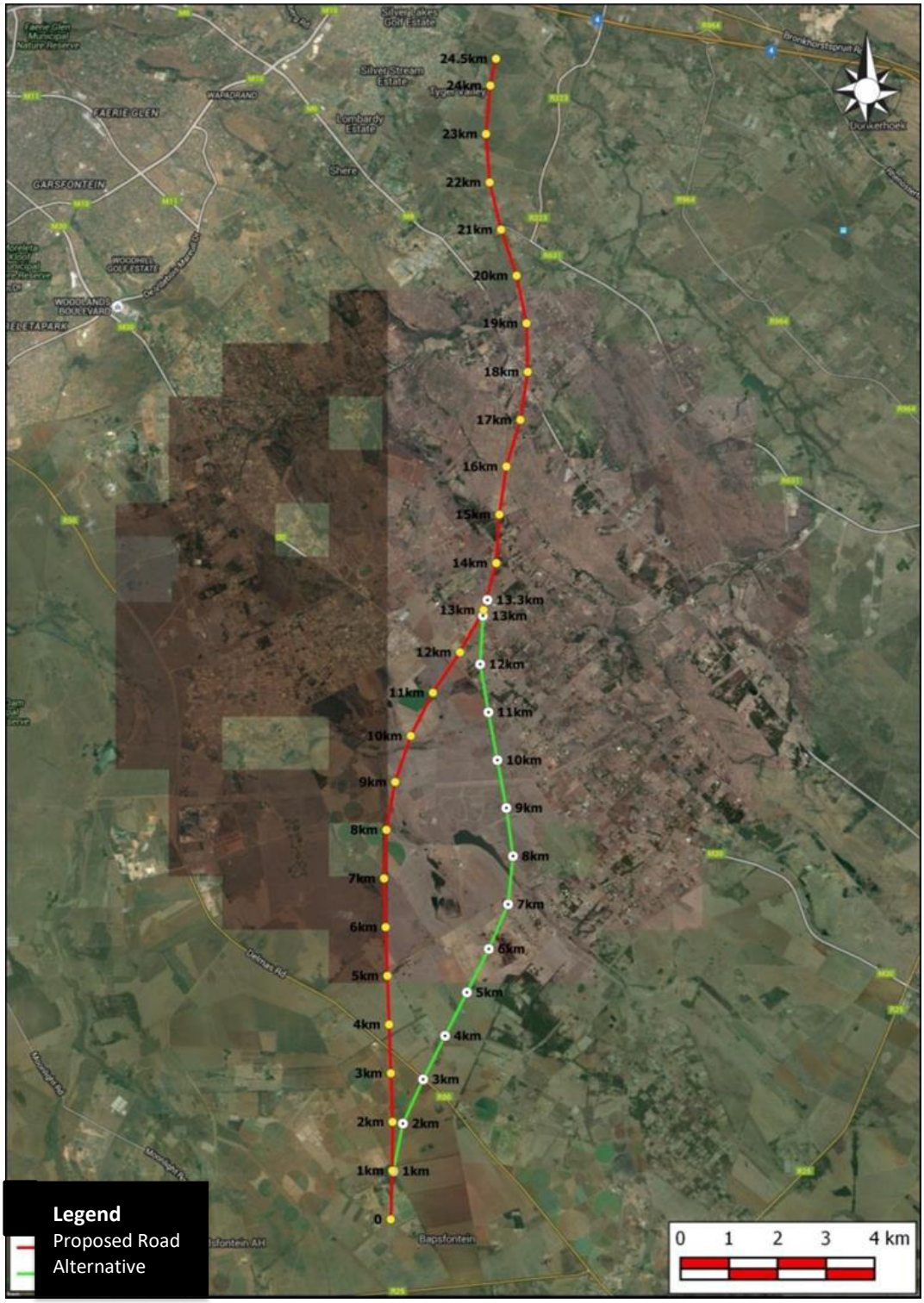

Figure 2 Aerial map of the study site indicating the 1 km intervals of the proposed road and ite alternative.

5. METHODS

The study site was visited on 18, 19 and 25 February, 2 March, and on 21 and 22 April 2016. The GPS coordinates for each 1 km interval was used as a guideline for the locality of the proposed road and the alternative road. Based on this, the vegetation that was situated in a 200m buffer from the GPS point was included in the survey. For each study unit identified, a species list was compiled for all plants recorded, using the adequate number of sampling plots (100 m by 25 m). Field guides such as those by Germishuizen and Meyer (2003), Johnson and Bytebier (2015), Koekemoer *et al*. (2014), Pooley (1998), van Ginkel *et al.* (2011), van Oudtshoorn *et al.* (2014), van Wyk and Malan (1998) and van Wyk (2013) were used to identify the species. The herbarium of the University of Pretoria (H. G. W. J. Schweickerdt Herbarium, University of Pretoria) was also visited to confirm the correct identification of species.

The survey also included information about the occurrence of Red and Orange List plant species obtained from GDARD (Pfab, 2002; Pfab and Victor, 2002) (Annexure A). The Red List Plant Species Guidelines and Requirements for Biodiversity Assessments v3. issued by GDARD (2014) was consulted. The plant species list for this QDS obtained from SANBI (Plants of Southern Africa: an online checklist) was consulted to verify the record of occurrence of the plant species recorded at the site. The Gauteng Conservation Plan (C-plan v3.3) was also consulted to evaluate ecologically sensitive areas.

Each study unit was further assessed for the occurrence of alien plant species (Bromilow, 2010) and any form of disturbance. Alien species are included in the species lists (in bold in the relevant tables) as they suggest the particular state of each study unit. For each alien species the Category is indicated according to the *Alien and Invasive species lists* (2014) amended in NEMBA (National Environmental Management: Biodiversity Act (ACT NO, 10 OF 2004).

For each plant species, the medicinal properties were assessed (van Wyk *et al*., 2013). Medicinal plants are marked with an asterisk in the respective tables. Harvesting of medicinal plants causes a decline of the particular species and, therefore, threatens the conservation of these species.

6. RESULTS

6.1 Medicinal and Alien plant species

Medicinal plant species and alien plant species are listed in **Table 1**. Medicinal plant species are marked with an asterisk * in the species lists (Tables 4, 6, 8, 10, 12 and 14). For the entire study site, the most plant species with medicinal properties were recorded in the rocky ridge vegetation. Of

these, *Boophane disticha, Gunnera purpensa* and *Hypoxis hemerocallidea* are the most threatened species (Annexure A).

Table 1 The number of plant species recorded per study unit, including the total number of medicinal and alien plant species.

Study unit	Total number of species	No. of medicinal species	No. of alien species
Grassland Vegetation	108	9	18
Wetland Vegetation	67	6	16
Rocky Ridge Vegetation	42	5	7
Bushveld Vegetation	63	4	6
Woodland Vegetation	48	7	6
Riverine Vegetation	30	5	12

The total number of alien plants per Category is indicated in **Table 2**. For each alien species the Category is indicated according to the Alien and Invasive species lists (2014) amended in NEMBA (National Environmental Management: Biodiversity Act (ACT NO, 10 OF 2004).

For **Category 1a** declared weeds removal is compulsory in terms of the regulations formulated under "The Conservation of Agricultural Resources Act" (Act No. 43 of 1983), as amended. Alien invasive species in this Category may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway.

Category 1b alien species are major invaders that may need government assistance to remove (Act No. 43 of 1983), as amended. These alien species must be contained, and in many cases they already fall under a government sponsored management programme such as Working for Water. Alien invasive species in this Category may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway.

All **Category 2** declared weeds should likewise be removed (Act No. 43 of 1983), as amended, unless a permit is obtained to control it in a demarcated area or a biological control reserve.

Category 3 declared weeds may not occur on any land or inland water surface other than in a biological control reserve. However, these provisions shall not apply if plants listed in Category 3 are already in existence at the time of the commencement of said regulations. In such cases, a land user must take all reasonable steps to restrict the spreading of propagating material of Category 3 plants.

Alien plants and the respective Category in the species lists are indicated in bold (Tables 6, 8, 10, 12 and 14).

Table 2 Number of alien plant species per study unit.

Study unit	Total number of alien species	CAT 1a	CAT 1b	CAT 2	CAT 3	Not declared
Grassland Vegetation	18	0	5	0	0	13
Wetland Vegetation	14	0	7	0	0	7
Rocky Ridge Vegetation	7	0	5	0	0	2
Bushveld Vegetation	6	0	5	0	0	1
Woodland Vegetation	6	0	3	0	1	2
Riverine Vegetation	13	0	7	2	2	2

6.2 Red and Orange List species

Twenty-one Red and Orange List species are known to occur in the QDS 2528CD (Annexure A). Of these species, four have been recorded in this study (Annexure A). Eight Red and Orange List species (Annexure A) have been recorded in a 5 km radius of the study site and surrounding areas, but were not recorded during this survey.

6.3 Study units

Six study units were identified (Figure 4):

1. Grassland Vegetation
2. Wetland Vegetation
3. Rocky Ridge Vegetation
4. Bushveld Vegetation
5. Woodland Vegetation
6. Riverine Vegetation

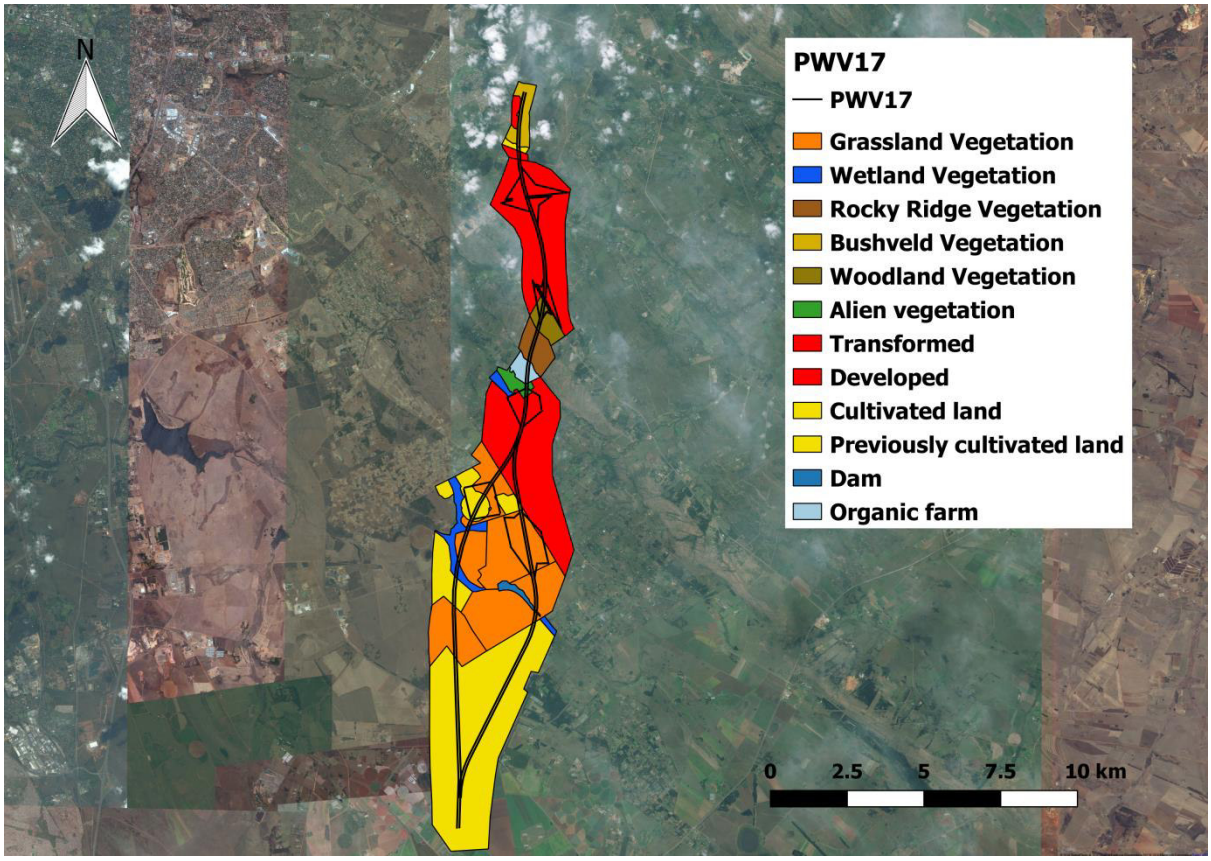

Figure 4 Study units identified for the proposed road PWV17 and the alternative.

6.4 Grassland Vegetation

6.4.1 Composition

The number of species per growth form is indicated in Table 3. In general, the grassland patches towards the south-west are in a semi-natural state (Figure 5). Grassland patches towards the north and north-east are more fragmented and used for grazing purposes. Some grassland patches are more degraded than others due to grazing pressure and alien vegetation. Dominant grass species include *Eragrostis* spp., *Heteropogon contortus* and *Themeda triandra*. The forb layer is dominated by *Berkheya radula, Gerbera ambigua, Helichrysum nudifolium, Hilliardiella oligocephala, Ledebouria revoluta, Nemesia fruticans, Polygala amatymbica, Polygala hottentotta, Tephrosia capensis* and *Wahlenbergia undulata* (Table 4).

Table 3 Number of species recorded for each growth form

GROWTH FORM	TOTAL NUMBER OF SPECIES
Tree/Shrub	9
Grass/Sedge	31
Forb	67
Succulent	1

6.4.2 Red and Orange List species

The two Orange List species, *Hypoxis hemerocallidea* and *Boophone disticha* were recorded for this study unit. There is suitable habitat for one Orange List species (*Callilepis leptophylla*) and three Red List species (*Argyrolobium campicola, Habenaria bicolor* and *Habenaria mossii*) (Annexure A).

6.4.3 Medicinal and Alien species

Ten medicinal species were recorded for this unit, of which *Hypoxis hemerocallidea* and *Boophone disticha* are the most threatened species. Alien species which dominate the landscape include *Campuloclinium macrocephalum, Cosmos bipinnatus, Plantago lanceolata, Tagetes minuta* and *Verbena bonariensis*.

6.4.4 Sensitivity and Connectivity

All of the grassland patches occur in the Critically Endangered Rietvleiriver Highveld Grassland, making the grassland vegetation ecologically sensitive. Some grassland patches are considered ecologically medium sensitive due to their natural state and their connectivity with other patches in addition to the two Orange List species that were recorded for these patches. Other patches cannot be regarded as typical of the Rietvleiriver Highveld Grassland due to grazing pressure, alien vegetation and development, and is therefore not sensitive.

Table 4 Species list for the Grassland Vegetation unit.

Scientific name	Invasive category
Aloe zebrina	
Alternanthera pungens	
Andropogon eucomus	
Andropogon schirensis	
Aristida congesta subsp. *barbicollis*	
Aristida congesta subsp. *congesta*	
Aristida stipitata	
Asclepias eminens	
Asparagus sp.	
Barleria macrostegia	
Barleria sp.	
Berkheya radula	
Bidens bipinnata	
*Boophone disticha**	
Brachiaria nigropedata	
Bulbostylis hispidula subsp. *pyriformis*	
Campuloclinium macrocephalum	**1b**
Chironia cf. *palustris*	
Chlorophytum cf. *fasciculatum*	
Chlorophytum transvaalense	
Cleome monophylla	
Commelina africana	
Commelina erecta	
Cosmos bipinnatus	
Crabbea angustifolia	

Cucumis zeyheri	
Cyanotis speciosa	
Cymbopogon caesius	
Cynodon dactylon	
Cyperus esculentus	
Datura stramonium*	
Dicoma anomala	
Digitaria eriantha	
Diheteropogon amplectens	
Diospyros lycioides subsp. *lycioides*	
Eleusine coracana	
Eragrostis chloromelas	
Eragrostis curvula	
Eragrostis gummiflua	
Eragrostis nindensis	
Eragrostis racemosa	
Eriosema cordatum	
Eucalyptus camaldulensis	**1b**
Euphorbia striata	
Felicia muricata	
Gerbera ambigua	
Gerbera piloselloides	
Gerbera sp.	
Gomphocarpus fruticosus subsp. *fruticosus**	
Gomphrena celosioides	
Helichrysum cf. *lineare*	
Helichrysum nudifolium var. *nudifolium **	
Hermannia depressa	
Heteropogon contortus	
Hibiscus microcarpus	
*Hilliardiella oligocephala**	
Hyparrhenia hirta	
Hypericum aethiopicum	
Hypochaeris radicata	
Hypoxis argentea	
*Hypoxis hemerocallidea**	
Hypoxis rigidula	
Indigofera cf. *melanadenia*	
Indigofera sp.	
Ipomoea cf. *crassipes*	
Justicia anagalloides	
Kalanchoe sp.	
Ledebouria revoluta	
Macledium zeyheri subsp. *zeyheri*	
Melinis repens	
Nemesia fruticans	
Nidorella anomala	
Oxalis depressa	
Panicum natalense	
Paspalum dilatatum	
Pelargonium luridum	

***Pinus* sp.**	
Plantago lanceolata	
Pollichia campestris	
Polygala amatymbica	
Polygala hottentotta	
Pseudognaphalium luteo-album	
Richardia brasiliensis	
Schizachyrium sanguineum	
Selago densiflora	
Senecio erubescens	
Senegalia caffra	
Seriphium plumosum	
Setaria sphacelata var. *torta*	
Solanum elaeagnifolium	**1b**
Solanum panduriforme	
Solanum sisymbriifolium	**1b**
Sporobolus africanus	
Sporobolus pectinatus	
Striga elegans	
Tagetes minuta	
Tephrosia capensis	
Themeda triandra	
Trachypogon spicatus	
Trichoneura grandiglumis	
Triraphis andropogonoides	
Urochloa panicoides	
*Vachellia karroo**	
Verbena aristigera	
Verbena bonariensis	**1b**
Wahlenbergia undulata	
Ziziphus mucronata subsp. *mucronata**	
Ziziphus zeyheriana	

Alien species are indicated in **bold**; medicinal species are indicated with *.

Figure 5 Grassland Vegetation.

6.5 Wetland Vegetation

6.5.1 Composition

The number of species per growth form category is indicated in Table 5. This site is dominated by hydrophytes and herbs. The wetland towards the north-west is in a good ecological state (Figure 6), but is threatened by surrounding agricultural activities. Dominant species include *Berkheya radula, Cyperus* spp*., Cycnium tubulosum, Gladiolus crassifolius, Gladiolus papilio, Haplocarpha scaposa, Mimulus gracilis, Monopsis decipiens, Schoenoplectus* spp., and *Typha capensis* (Table 6).

Table 5 Number of species recorded in each growth form.

GROWTH FORM	TOTAL NUMBER OF SPECIES
Shrub/Tree	1
Grass/Sedge	18
Forb	49
Succulent	0

6.5.2 Red and Orange List species

One Orange List species, namely *Gunnera purpensa,* was recorded in this study unit. The habitat is suitable for three Orange List species and one Red List Species (Annexure A).

6.5.3 Medicinal and Alien species

Seven medicinal species were recorded for this unit, of which *Gunnera purpensa* is the most threatened species. Seven alien species in this unit are classified as Category 1b invaders. Alien

species which dominate the landscape include *Campuloclinium macrocephalum, Cosmos bipinnatus, Flaveria bidentis, Hibiscus trionum, Persicaria lapathifolia, Tagetes minuta and Verbena bonariensis.* *Asclepias curassavica* (Figure 7) is not listed on POSA; it is therefore possible that this could be the first record for this species in the QDS 2528CD.

6.5.4 Sensitivity and Connectivity

This unit is regarded as highly sensitive and should be excluded from development. Wetland connectivity is mainly intact, especially towards the north-west. Alien vegetation and agricultural activities threaten the ecological status and connectivity of these wetlands.

Table 6 Species list for the Wetland Vegetation.

Scientific name	**Invasive Category**
Alectra sessiliflora	
Amaranthus deflexus	
Aristida diffusa	
Aristida junciformis	
Arundinella nepalensis	
Asclepias curassavica	
Berkheya radula	
*Berula erecta**	
Cosmos bipinnatus	
Campuloclinium macrocephalum	**1b**
Chlorophytum transvaalense	
Cleome maculata	
Commelina africana	
Conyza bonariensis	
Cordylogyne globosa	
Cycnium tubulosum	
Cynodon dactylon	
Cyperus cf. *congestus*	
Cyperus esculentus var. *esculentus*	
Cyperus margaritaceus var. *margaritaceus*	
Datura stramonium*	**1b**
Denekia capensis	
Digitaria argyrograpta	
Eleocharis dregeana	
Eragrostis chloromelas	
Flaveria bidentis	**1b**
Gladiolus crassifolius	
Gladiolus papilio	
*Gunnera purpensa**	
Haplocarpha scaposa	
*Helichrysum nudifolium var. nudifolium**	
Helichrysum sp.	

Hibiscus trionum	
Imperata cylindrica	
Kyllinga erecta	
Lobelia flaccida	
Lotononis laxa	
Mimulus gracilis	
Monopsis decipiens	
Nesaea schinzii	
Nidorella anomala	
Nymphoides indica subsp. *occidentalis*	
Oxalis depressa	
Paspalum dilatatum	
Pennisetum clandestinum	**1b**
Persicaria decipiens	
Persicaria lapathifolia*	
Ranunculus multifidus	
Schoenoplectus brachyceras	
Schoenoplectus cf.*decipiens*	
Selago densiflora	
Senecio sp.	
Setaria incrassata	
Setaria sphacelata var. *sphacelata*	
Setaria sphacelata var. *torta*	
Solanum mauritianum	**1b**
Solanum sisymbriifolium	**1b**
Sonchus cf. *nanus*	
Sorghum bicolor	
Sporobolus africanus	
Striga elegans	
Tagetes minuta	
Themeda triandra	
*Typha capensis**	
Urochloa trichopus	
Verbena bonariensis	**1b**
Veronica anagallis-aquatica	

Alien species are indicated in **bold**; medicinal species are indicated with *.

Figure 6 Wetland vegetation.

Figure 7 *Asclepias curassavica*

6.6 Rocky Ridge Vegetation

6.6.1 Composition

The number of species per growth form category is indicated in Table 7. The southern slope of the Bronberg has less species and a smaller area affected. Dominat tree and shrub species include *Diospyros lycioides, Searsia lancea, Searsia magalismontana* and *Vangueria infausta.* The forb layer is dominated by *Adiantum capillus-veneris, Commelina modesta, Euryops laxus, Kohautia amatymbica, Leonotis randii, Senecio venosus, Tephrosia elongata* and *Xerophyta retinervis* (Table 8).

The northern slope of the Bronberg has a much larger area affected by the proposed road and is more species rich compared to the southern slope (Figure 8). More indigenous tree and shrub species were recorded for the northern slope, including *Combretum molle, Diospyros lycioides, Euclea crispa, Searsia lancea, Searsia pyroides* and *Vachellia karroo.* Dominant forbs include *Adiantum capillus-veneris, Bulbostylis hispidula, Commelina africana, Kohautia amatymbica* and *Xerophyta retinervis* (Table 8).

Table 7 Number of species recorded in each growth form

GROWTH FORM	TOTAL NUMBER OF SPECIES
Shrub/Tree	12
Graminoids	7
Forb	22

6.6.2 Red and Orange List species

No Red or Orange List species were recorded for this unit. The habitat is suitable for three Red List species (Annexure A).

6.6.3 Medicinal and Alien plant species

Five medicinal and seven alien species were recorded for this study unit. Alien species which dominate the southern slope include *Jacaranda angustifolia, Opuntia ficus-indica, Priva cordifolia, Richardia brasiliensis, Solanum sisymbriifolium* and *Solanum mauritianum*. For the northern slope, only *Eucalyptus* sp. was recorded. Six of the species are Category 1b invaders.

6.6.4 Sensitivity and Connectivity

This site is regarded as highly sensitive as it is in a natural state and connectivity is still intact. The Bronberg is considered a Class 2 ridge according to GDARD C-Plan. Minimum disturbances occur and only a few alien species occur on site.

Table 8 Species recorded in the Rocky Ridge Vegetation.

Scientific name	**Invasive category**
Adiantum capillus-veneris	
Aristida junciformis	

Asparagus suaveolens	
Bulbostylis hispidula subsp. *pyriformis*	
Campuloclinium macrocephalum	**1b**
Ceratotheca triloba	
Chamaecrista comosa	
Coleochloa setifera	
*Combretum molle**	
Commelina africana	
Commelina modesta	
Diheteropogon amplectens	
Diospyros lycioides subsp. *lycioides*	
Eucalyptus camaldulensis	**1b**
Euclea crispa	
Euryops laxus	
Hibiscus sp.	
*Hilliardiella oligocephala**	
Jacaranda angustifolia	**1b**
Kohautia caespitosa	
Kohautia sp.	
Leonotis randii	
Melinis repens	
Opuntia ficus-indica	**1b**
Panicum natalense	
*Pellaea calomelanos**	
Priva cordifolia	
Rhynchosia monophylla	
Richardia brasiliensis	
Schizachyrium cf. *jeffreysii*	
Searsia lancea	
Searsia magalismontana	
Searsia pyroides	
Senecio venosus	
Solanum mauritianum	**1b**
Solanum sisymbriifolium	**1b**
Sphenostylis angustifolia	
Tephrosia elongata	
Trachypogon spicatus	
*Vachellia karroo**	
Vangueria infausta	
*Xerophyta retinervis**	

Alien species are indicated in **bold**; medicinal species are indicated with *.

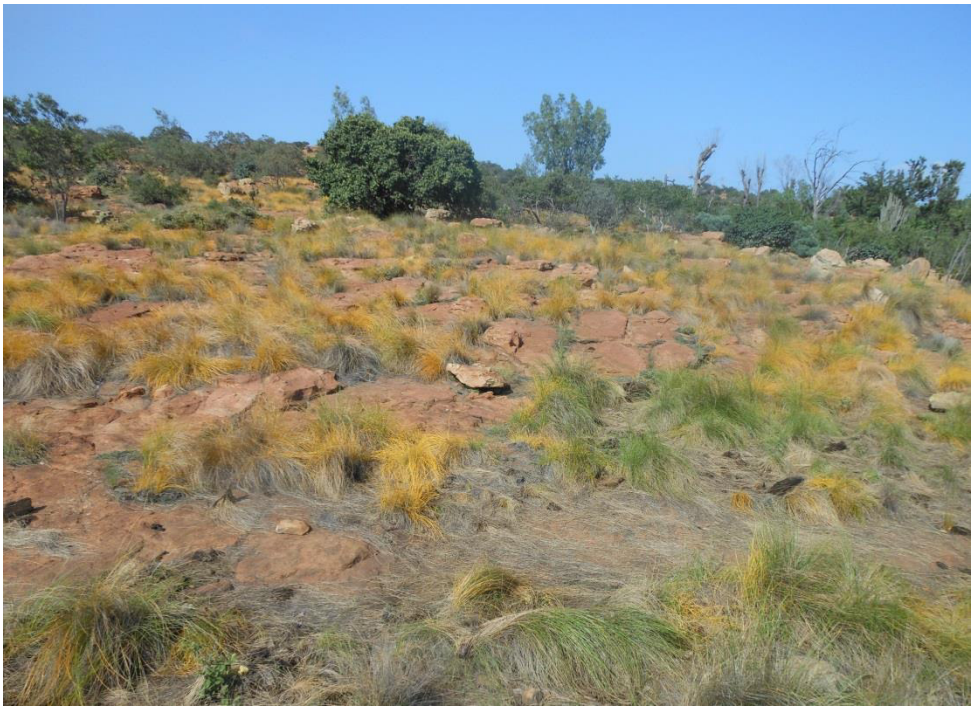

Figure 8 The rocky ridge vegetation on the northern slope of the Bronberg.

6.7 Bushveld Vegetation

6.7.1 Composition

The number of species per growth form category is indicated in Table 9. The vegetation is in a natural state (Figure 9), but threatened by increasing urban development from the west. Dominant tree and shrub species include *Diospyros lycioides*, *Searsia lancea*, *Searsia pyroides*, *Vachellia karroo* and *Vachellia tortilis*. The forb layer is dominated by *Acalypha angustata, Aloe greatheadii, Amaranthus deflexus, Chaetacanthus setiger, Felicia muricata, Helichrysum nudifolium, Hilliardiella oligocephala, Hypoxis rigidula, Polygala amatymbica, Polygala hottentotta, Scabiosa columbaria* and *Tephrosia capensis* (Table 10).

Table 9 Number of species recorded in each growth form

GROWTH FORM	TOTAL NUMBER OF SPECIES
Shrub/Tree	6
Grass/Sedge	18
Forb	39
Succulent	0

6.7.2 Red and Orange List species

One Red List species (*Habenaria kraenzliniana*) and one Orange List species (*Hypoxis hemerocallidea*) were recorded in this study unit (Annexure A). The appropriate buffer of 400m was applied for *H. kraenzliniana* in the sensitivity map (Figure 11). This species should be protected *in situ,* and no construction may take place within the buffer zone. The Orange List species is threatened due to it

being harvested for its medicinal properties. There is also suitable habitat for two other Red List species (Annexure A).

6.7.3 Medicinal and Alien species

Seven medicinal and six alien species were recorded for this study unit. *Hypoxis hemerocallidea* is the most threatened medicinal species in this unit. Alien species which are abundant in this unit include *Campuloclinium macrocephalum, Lantana camara, Solanum mauritianum* and *Solanum sisymbriifolium.*

6.7.4 Sensitivity and Connectivity

This site is considered highly sensitive due to the occurrence of a Red List species and the natural state of the habitat. Connectivity towards the east is restricted due to urban expansion, but less restricted to the west consisting of mixed land uses. The study unit is fragmented by the construction of the N4 highway towards the north; therefore there is no connectivity with surrounding patches.

Table 10 Species recorded for the Bushveld Vegetation.

Scientific name	**Invasive Category**
Acalypha angustata	
Aloe greatheadii var. *davyana*	
Amaranthus deflexus	
Andropogon schirensis	
Aristida adscensionis	
Aristida congesta subsp. *barbicollis*	
Aristida stipitata	
Asparagus suaveolens	
Brachiaria nigropedata	
Campuloclinium macrocephalum	**1b**
Chaetacanthus cf. *setiger*	
Chamaecrista comosa	
Chlorophytum cooperi	
Clematis brachiata	
Crabbea acaulis	
Cyanotis speciosa	
Cymbopogon caesius	
Digitaria eriantha	
Diheteropogon amplectens	
Diospyros lycioides subsp. *guerkei*	
Eragrostis capensis	
Eragrostis curvula	
Eragrostis nindensis	
Felicia muricata	
Gazania krebsiana	
Habenaria kraenzliniana	

Helichrysum nudifolium var. *nudifolium**	
Hermannia depressa	
Heteropogon contortus	
*Hilliardiella oligocephala**	
Hyparrhenia hirta	
Hypoxis argentea	
*Hypoxis hemerocallidea**	
Hypoxis multiceps	
Hypoxis rigidula var. rigidula	
Indigofera comosa	
Kalanchoe sp.	
Lantana camara	**1b**
Macledium zeyheri	
Melinis repens	
Monocymbium ceresiiforme	
Pentanisia angustifolia	
Pollichia campestris	
Polygala amatymbica	
Polygala hottentotta	
*Scabiosa columbaria**	
Searsia lancea	
Searsia pyroides	
Senecio venosus	
Seriphium plumosum	
Setaria sphacelata	
Solanum mauritianum	**1b**
Solanum panduriforme	
Solanum sisymbriifolium	**1b**
Sonchus oleraceus	
Sorghum bicolor	
Striga gesnerioides	
Tephrosia capensis	
Themeda triandra	
Trachypogon spicatus	
*Vachellia karroo**	
Vachellia tortilis subsp. *heteracantha*	
Verbena bonariensis	**1b**

Alien species are indicated in **bold**; medicinal species are indicated with *.

Figure 9 Bushveld vegetation.

6.8 Woodland Vegetation

6.8.1 Composition

The number of species per growth form category is indicated in Table 11. The tree canopy covers most of this unit with some open woodland areas towards the Bronberg (Figure 10). Dominant species include *Celtis africana, Dombeya rotundifolia, Eragrostis nindensis, Ehretia rigida, Helichrysum nudifolium, Heteropogon contortus, Melinis repens, Searsia lancea, Themeda triandra* and *Vachellia karroo* (Table 12).

Table 11 Number of species recorded in each growth form

GROWTH FORM	TOTAL NUMBER OF SPECIES
Shrub/Tree	16
Grass/Sedge	11
Forb	20
Succulent	1

6.8.2 Red and Orange List species

No Red or Orange List species were recorded for this site. The site is suitable for at least one Red List species and two Orange List species (Annexure A).

6.8.3 Medicinal and Alien species

Seven medicinal and six alien species were recorded for this study unit. Three alien species are Category 1b invaders and one species a Category 3 invader.

6.8.4 Sensitivity and Connectivity

This site is not considered sensitive, but is still in a natural state. There is limited connectivity of this unit due to infrastructure development towards the west and the east.

Table 12 Species recorded for the Woodland Vegetation.

Scientific name	**Invasive Category**
Acalypha angustata	
Aloe greatheadii var. *davyana*	
Aristida congesta subsp. *barbicollis*	
Asparagus suaveolens	
Brachiaria nigropedata	
Campuloclinium macrocephalum	**1b**
Celtis africana	
*Combretum molle**	
Crabbea acaulis	
Cucumis zeyheri	
Cussonia paniculata	
Cyanotis speciosa	
Cymbopogon caesius	
*Dombeya rotundifolia**	
Ehretia rigida subsp. *nervifolia*	
Eragrostis nindensis	
Eragrostis racemosa	
Erythrina lysistemon	
Euclea crispa	
Ficus salicifolia	
Gomphocarpus fruticosus subsp. *fruticosus**	
Helichrysum nudifolium var. *nudifolium **	
Hermannia depressa	
Heteropogon contortus	
Hypoxis iridifolia	
Indigofera zeyheri	
Kalanchoe sp.	
Lantana camara	**1b**
Ledebouria ovatifolia	
Macledium zeyheri	
Melia azedarach*	**1b**
Melinis repens	
*Pellaea calomelanos**	

Pollichia campestris	
Schizachyrium sanguineum	
Searsia lancea	
Senecio venosus	
Senegalia caffra	
Setaria sphacelata	
Solanum panduriforme	
Sporobolus fimbriatus	
Tagetes minuta	
Themeda triandra	
Tipuana tipu	**3**
*Vachellia karroo**	
Vangueria infausta	
Wahlenbergia undulata	
Zinnia peruviana	

Alien species are indicated in **bold**; medicinal species are indicated with *.

Figure 10 Woodland vegetation.

6.9 Riverine Vegetation

6.9.1 Composition

The number of species per growth form category is indicated in Table 13. The riverine vegetation is disturbed by alien vegetation (Figure 11). Dominant species include *Arundo donax*, *Berkheya radula, Celtis africana, Combretum erythrophyllum, Imperata cylindrica, Typha capensis,* and *Vachellia karroo* (Table 14).

Table 13 Number of species recorded in each growth form

GROWTH FORM	TOTAL NUMBER OF SPECIES
Shrub/Tree	14
Grass/Sedge	9
Forb	7
Succulent	0

6.9.2 Red and Orange List species

No Red or Orange List species were recorded for this site.

6.9.3 Medicinal and Alien species

Five medicinal and twelve alien species were recorded for this study unit. Seven alien species are Category 1b invaders, two species Category 2 invaders and two species Category 3 invaders (Table 14).

6.9.4 Sensitivity and Connectivity

This unit is highly disturbed due to the high numbers of alien species. It is not considered sensitive from a current vegetation perspective; however, it is a riverine system which provides important ecological services and is therefore, important to preserve.

Table 14 Species recorded for the Riverine Vegetation.

Scientific name	Invasive Category
Acacia mearnsii	**2**
Arundo donax	**1b**
Asparagus laricinus	
Berkheya radula	
Bidens pilosa	
Buddleja salviifolia	
Campuloclinium macrocephalum	**1b**
Celtis africana	
Celtis australis	**3**
*Combretum erythrophyllum**	
Cymbopogon caesius	
Digitaria eriantha	
Eucalyptus camaldulensis	**1b**
Gomphocarpus fruticosus subsp. *fruticosus**	
Hyparrhenia hirta	
Imperata cylindrica	
Ipomoea purpurea	**1b**
Melinis repens	
Morus alba	**3**
Panicum coloratum	

Phragmites australis	
Pyracantha angustifolia	**1b**
Salix babylonica	**2**
Searsia lancea	
Sesbania punicea	**1b**
Tagetes minuta	
Themeda triandra	
*Typha capensis**	
*Vachellia karroo**	
Verbena brasiliensis	**1b**
*Ziziphus mucronata**	

Alien species are indicated in **bold**; medicinal species are indicated with *.

Figure 11 The degraded Zwavelpoortspruit.

7. FINDINGS AND POTENTIAL IMPLICATIONS

There are several sensitive units identified for this study site: wetland vegetation, rocky ridge vegetation and bushveld vegetation (Figure 12). One Red List species was recorded for this study, and two Orange List species.

Wetland areas are generally considered ecologically sensitive and should be conserved. The proposed road development will affect large areas of wetland, while the proposed alternative road would have a lower impact. Through proper and efficient implementation of the recommended mitigation measures (discussed in section 8) the potential adverse impacts on the proposed

alternative road could be mitigated which would reduce the level of adverse impacts. However, even when rigid mitigation measures are implemented for the proposed road, some wetland habitat might be irreversibly lost.

The rocky ridge (Bronberg Mountain Range) is considered extremely sensitive. The habitat is suitable for two Red List species, both indicated as Vulnerable (Annexure A). Although not recorded in this study, an effort should be made to search for and record these species.

The bushveld vegetation at the northern end of the proposed road is considered highly sensitive as there is a low presence of alien species, intermediate disturbances (mainly due to urban expansion), and the presence of a Red List species. There is a probability of recording two more Red List species for this site. It is suggested that this section of the proposed road be reconsidered due to the high sensitivity of the area, or permission from GDARD should be obtained for the removal of the Red List species.

Although not indicated as sensitive, the grassland vegetation has suitable habitats for two Red List species and five Orange List species of which two were recorded in this study. This grassland should be conserved if possible, especially if Red List species are found. If the proposed road development will proceed, it would cause fragmentation of this grassland which is already under threat due to agriculture in the area. The grassland patches affected by the proposed alternative road is mainly for grazing purposes; therefore grassland vegetation is less sensitive for the proposed alternative road.

Also not indicated as sensitive, the riverine system is disturbed due to encroachment of alien species. However, proper care should be taken when constructing a road across rivers/watercourses. The necessary mitigation measures should be followed to ensure that further degradation of this unit does not occur.

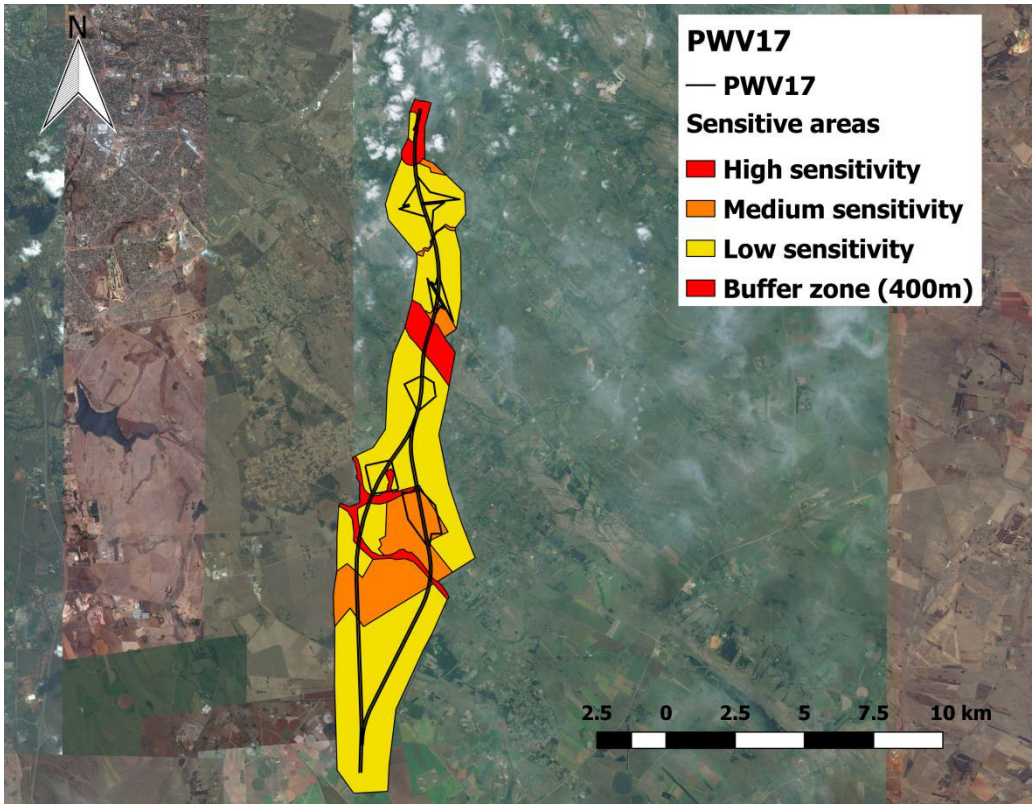

Figure 12 Map indicating the sensitive areas of the study site

8. DISCUSSION, RECOMMENDATIONS AND MITIGATION MEASURES

Competent and appropriate management authority should be appointed to implement the Ecological Management Plan (EMP) and Environmental Impact Assessment (EIA) conditions throughout all phases of development, including the operational phase. The EMP should comply with the *Minimum Requirements for Ecological Management Plans* according to GDARD. The EMP and EIA should take into account all recommendations and mitigation measures as outlined by all vegetation assessments conducted for the EIA process. The following recommendations and mitigation measures are proposed:

- The attached sensitivity map (Figure 12) should be used as a decision tool to guide the layout design.
- Before construction is initiated, ecologically sensitive areas should be fenced-off from construction, and all construction-related impacts must be contained within the fenced-off development areas. These areas should be demarcated on site layout plans. All construction-related impacts (including service roads, temporary housing, temporary ablution, disturbance of natural habitat, storing of equipment/building materials/vehicles or any other

activity) should be excluded from ecologically sensitive areas. An overspill of construction activities into areas outside of the study area is permitted within designated non-sensitive areas. No personnel or vehicles may be permitted in ecologically sensitive areas except for those authorised to do so.

- A pre- and post-construction alien and invasive control, monitoring, and eradication programme must be implemented along with an ongoing programme to ensure persistence of indigenous species. A qualified botanist/ecologist should compile and supervise the implementation of this programme.
- Rehabilitation of natural vegetation should proceed in accordance with a rehabilitation plan compiled by a specialist registered in terms of the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science.
- Where active rehabilitation or restoration is mandatory for terrestrial systems, it should make use of indigenous plant species native to the study area, but would otherwise be destroyed during clearing for development purposes, for example *Celtis africana*, *Vachellia karroo,* and *Hypoxis hemerocallidea.* The species selected should strive to represent habitat types typical of the ecological landscape prior to construction. Forage and host plants required by pollinators should also be planted in landscaped areas.
- It is strongly prohibited for Red List species to be relocated, but should be protected *in situ* according to GDARD. This means that if any Red List species is recorded on site, all development activity should be stopped, a qualified botanist should be consulted and the relevant buffers should be applied. No construction may take place within a buffered area of a Red List species. If not possible to protect *in situ*, permission should be obtained from GDARD for the removal of such Red List species.

9. CONCLUSIONS

The EMP and the proposed mitigation measures should be followed. Certain study units, indicated above, are highly sensitive and should be excluded from development. These include the wetland vegetation, rocky ridge vegetation (Bronberg) and the bushveld vegetation. If the proposed road or its alternative is approved, adverse impacts should be mitigated and where required, a rehabilitation plan should be followed. The northern section of the proposed road should be reconsidered as a Red List species was recorded in the area. If the relevant authority (GDARD) decides to rescue the plant, it should be translocated to favourable habitat or included in a breeding programme. This is not generally supported by GDARD as all Red List species should be protected *in situ*.

If the proposed road or its alternative is approved, dumping of builders' rubble and other waste must be prevented in ecologically sensitive areas (Figure 11). These areas should be properly managed throughout the lifespan of the project to ensure continuous biodiversity. The disturbed

alien vegetation study unit can be used for storage of building material used for development. Alien plant species, especially in Category 1 and 2 must be eradicated as a matter of urgency to preclude their spreading during the construction phase in addition to a clean-up programme after construction.

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Appendix A: Red List Species (confidential)

The following Red List species occur in the quarter degree grid 2528CD. An indication is also provided if a species was recorded on site and whether suitable habitat exists on site.

Species	Habitat Description and Flowering Season	Conservation status	Probability of occurring on site
Adromischus umbraticola subsp. *umbraticola*	Rock crevices on rocky ridges, usually south-facing, or in shallow gravel on top of rocks, but often in shade of other vegetation. (September – January)	Near Threatened	Not found – **Suitable habitat**
Argyrolobium campicola	Highveld grassland. (November – February)	Near Threatened	Not found - **Suitable habitat**
Boophane disticha	**Dry grassland and rocky areas. (October – January)**	**Declining**	**Found on site**
Boweia volubilis subsp. *volubilis*	Shady places, steep rocky slopes and in open woodland, under large boulders in bush or low forest. (September-April)	Vulnerable	Not found- **Suitable habitat**
Brachycorythis conica subsp. *transvaalensis*	Short grasslands, hillsides, on sandy gravel overlying dolomite, sometimes also on quartzites; occasionally open woodland; 1000 - 1705m. (January – March)	Endangered	Not found - **Suitable habitat**
Callilepis leptophylla	Grassland or open woodland, often on rocky outcrops or rocky hillslopes. (August-January & May)	Declining	Not found - **Suitable habitat**
Ceropegia decidua subsp. *pretoriensis*	Direct sunshine or shaded situations, rocky outcrops of the quartzitic Magaliesberg mountain series, in pockets of soil among rocks, in shade of shrubs and low trees, can be seen twining around grass spikes. (November –April)	Vulnerable	Not found - **Suitable habitat**
Cheilanthes deltoidea subsp. silicicola	Southwest-facing soil pockets and rock crevices in chert rock. (November-April)	Vulnerable	Not found
Crinum macowanii	Grassland, along rivers, in gravelly soil or on sandy flats. (October – January)	Declining	Not found - **Suitable habitat**
Delosperma leendertziae	Rocky ridges; on rather steep south facing slopes of quartzite in mountain grassveld. (October – April)	Near Threatened	Not found
Eucomis autumnalis	Damp, open grassland and sheltered places. (November – April)	Declining	Not found - **Suitable habitat**
Eulophia coddii	Steep hillsides on soil derived from sandstone, grassland or mixed bush. (Early December)	Vulnerable	Not found - **Suitable habitat**
Gunnera purpensa	**In cold or cool, continually moist localities, mainly along upland streambanks. (October – March)**	**Declining**	**Found on site**
Habenaria barbertoni	In grassland on rocky hillsides. (February – March)	Near Threatened	Not found
Habenaria bicolor	Well-drained grasslands at around	Near	Not found -

	1600m. (January – April)	Threatened	**Suitable habitat**
Habenaria kraenzliniana	**Terrestrial in stony, grassy hillsides, recorded from 1000 to 1400m. (February – April)**	**Near Threatened**	**Found on site**
Habenaria mossii	Open grassland on dolomite or in black sandy soil. (March – April)	Endangered	Not found - **Suitable habitat**
Hypoxis hemerocallidea	**Occurs in a wide range of habitats, from sandy hills on the margins of dune forests to open rocky grassland; also grows on dry, stony, grassy slopes, mountain slopes and plateaux; appears to be drought and fire tolerant. (September – March)**	**Declining**	**Found on site**
Miraglossum leave	Terrestrial (November – January)	Critically Endangered	Not found
Searsia gracillima	Rocky quartzitic outcrops in bushveld. (January – April)	Near Threatened	Not found - **Suitable habitat**
Stenostelma umbelluliferum	Deep black turf in open woodland mainly in the vicinity of drainage lines. (September – March)	Near Threatened	Not found - **Suitable habitat**

Appendix B: Photos and GPS coordinates of Red List Species

Habenaria kraenzliniana leaves and stem.

Habenaria kraenzliniana inflorescence.

Species	GPS coordinates
Habenaria kraenzliniana	**25°47'29.57"S; 28°23'13.90"E**

AVIFAUNA ASSESSMENT OF PORTIONS ON THE FARMS TWEEFONTEIN 19, HATHERLEY 331, ZWARTKOPPIES 364, MOOIPLAATS 367, TIEGERPOORT 371, ZWAVELPOORT 373, GROOTFONTEIN 394, ELANDSFONTEIN 412 AND TWEEFONTEIN 413

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Report Reviewed by: Lukas Niemand (MSc Zoology: Pr. Sci. Nat.)

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1. Introduction

Bokamoso Environmental Consultants CC; Specialist Division was appointed to conduct a Avifaunal Assessment for the proposed road development known as PWV 17 and its alternative route on portions of the Farm Tweefontein 19, Farm Hatherley 331, Farm Zwartkoppies 364, Farm Mooiplaats 367, Farm Tiegerpoort 371, Farm Zwavelpoort 373, Farm Grootfontein 394, Farm Elandsfontein 412 and Farm Tweefontein 413. (hereafter referred to as the study area).

This report is based on the avifaunal species present on the study area as well as species that could potentially occur. The report primarily focuses on species with conservation concerns **(NT** = Near Threatened, **VU** = Vulnerable, **EN** = Endangered, **CR** = Critically Endangered) and other species with conservation importance occurring on or near the study area to ensure that, should any such species exists, the appropriate actions are taken to guarantee the well-being of these species.

2. Scope of the study

- To identify as many avifaunal species as possible present on the study area.
- To identify all the distinct avifaunal habitats on the study area.
- To compare the species occurring in and around the study area with all the species that has been recorded in that area in recent history.
- To identify ecologically sensitive areas in terms of species occurrence and/ or habitat.
- To provide lists of all the bird species occurring on the study area as well as species possibly occurring in the area as a result of habitat preferences and previous records.
- To provide a list of species with conservation importance.
- To provide recommendations in the form of mitigation of negative impacts, should the development be approved.

3. Study Area

The study area is situated between the R25 in the South, close to the town Bapsfontein and the N4 highway to the North, next to Silver Lakes Estate (**Figure 1 and 2**). The aerial map (**Figure 2**) indicates the 1 km intervals for each of the two alternatives starting from south to north. The proposed road alignment crosses several existing roads including the R50 Delmas Road, the M30 Garsfontein Road, M6 Graham Road and the R631 Boschkop Road. The size of the study area is approximately 5 000 hectares and is located within the 2528CD quarter degree square (QDS) (25˚59'28.54"S; 28˚22'06.97"E southernmost end, 25˚52'36.48"S; 28˚23'17.64"E midpoint, 25˚46'35.13"S; 28˚23'22.82"E northernmost end) and within the 2545_2820, 2550_2820 and 2555_2820 pentads (A pentad is a 5 minute x 5 minute coordinate grid super-imposed over the continent for spatial reference, one QDS comprises of 9 pentads) (SABaP2). The study area transects four vegetation units according to Mucina and Rutherford (2006)

including: Carletonville Dolomite Grassland, Rand Highveld Grassland, Andesite Mountain Bushveld and Marikana Thornveld.

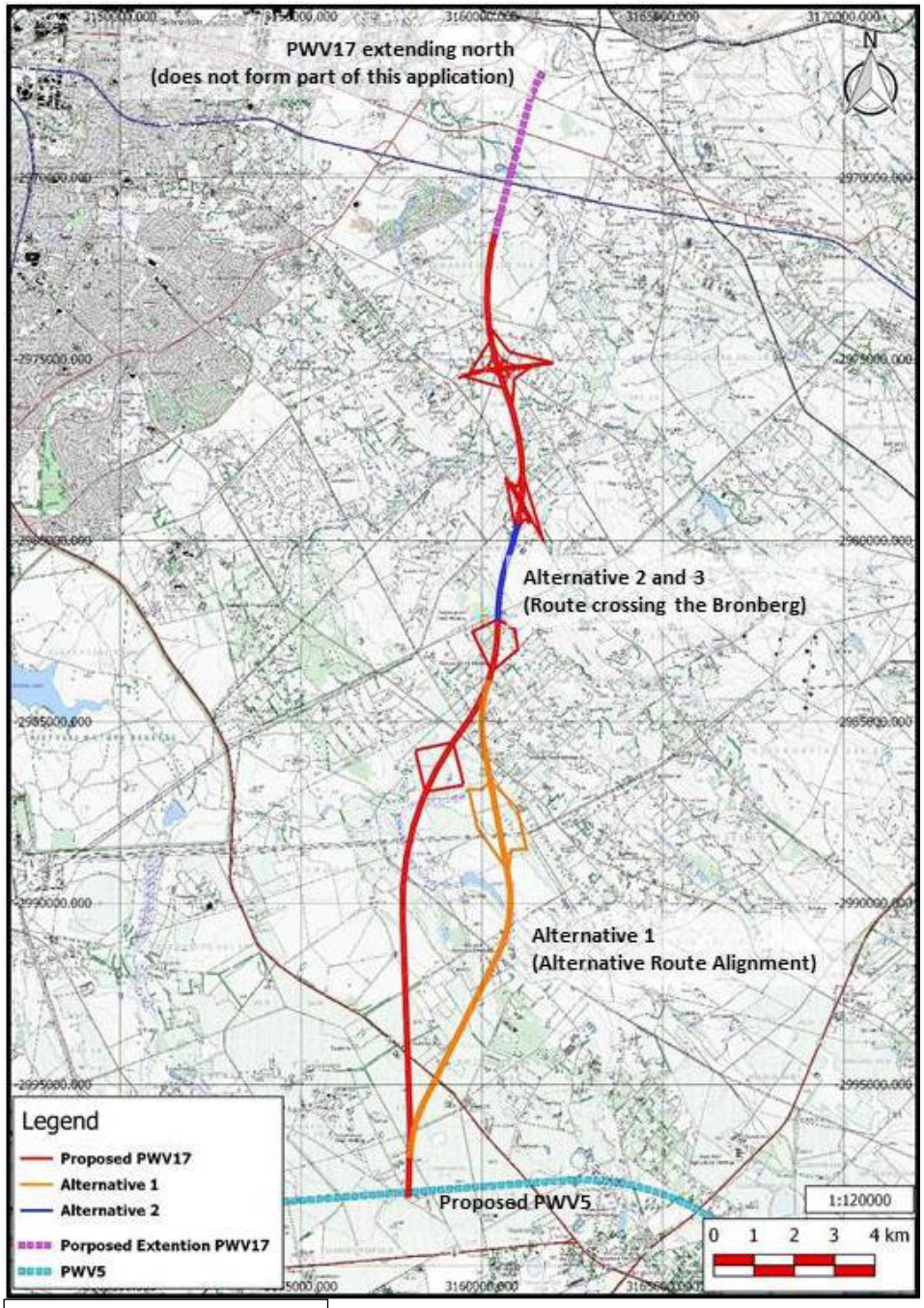

Figure 1: Locality Map

A locality map showing all the surrounding roads and open space as well as the two alternative routes for the proposed road development.

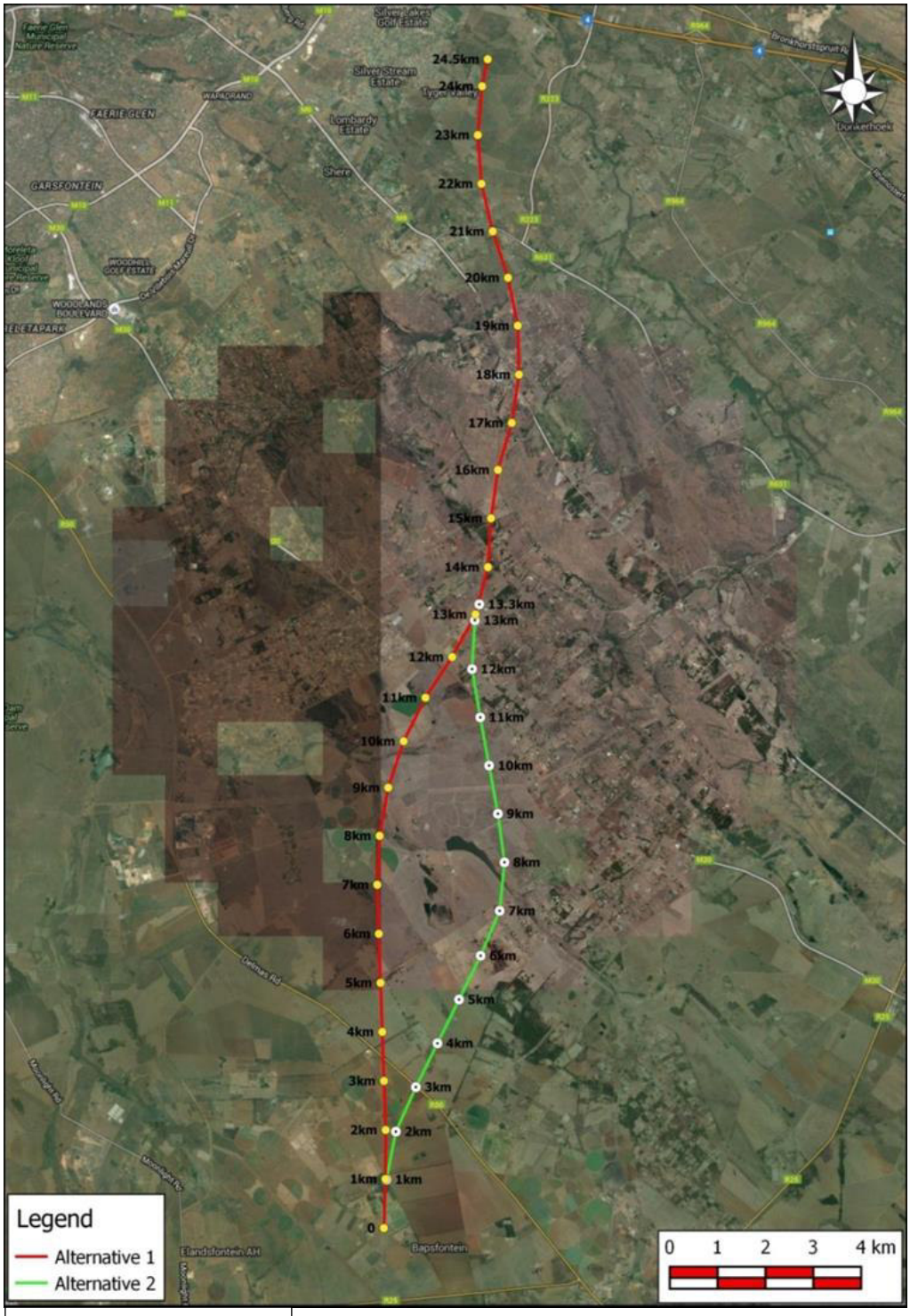

Figure 2: Aerial photo

An aerial photo of the study area indicating 1 km intervals for each of the two alternatives from south to north.

4. Methods

4.1 Field Survey

Multiple field surveys were conducted on the 2 of March and on the 21st and 22nd April 2016. A total of 18 hour (6 hours per day) was spent on the study area whilst conducting the field survey. Before conducting a field survey a desktop assessment was conducted to document the prevalent avifaunal species occurring on or near the site. A list of expected species was compiled and used as a reference during the field surveys to ensure that bird species that should theoretically occur were not overlooked. All distinct avifaunal habitats were identified on site, after which each habitat was assessed to record the associated avifaunal species present in that specific habitat. Species were identified by actual sightings, calls as well as signs of presence in the form of eggshells, nests, droppings and feathers (Chris & Tilde Stuart., 2000). Where necessary, species were verified using Sasol Birds of Southern Africa (Sinclair *et al.*, 2011).

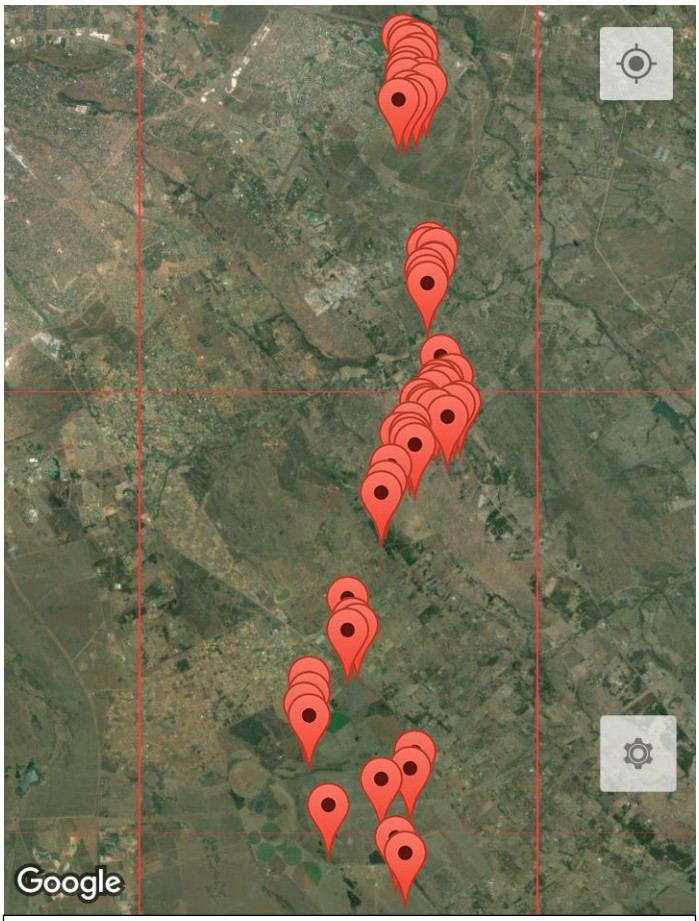

Figure 3: GPS waypoints for each bird species

The geographical position of each bird species recorded within the study area, thereby illustrating the relative density of birds in the area. These observed species are color coded and listed in Table 1 (Recorded on site – 5)

4.2 Listing all the possible species occurring on site

By using Southern Africa Bird Atlas Project 1 and 2 (SABAP2) a comprehensive species list could be compiled for the 2528CD QDS and the 2545_2820, 2550_2820 and 2555_2820 pentads. SABAP2 is the follow-up project to the Southern African Bird Atlas Project (for which the acronym was SABAP, and which is now referred to as SABAP1). This first bird atlas project took place from 1987-1991. The second bird atlas project started on 1 July 2007 and plans to run indefinitely. The project aims to map the distribution and relative abundance of birds in southern Africa. The field work for this project is done by more than one thousand nine hundred volunteers, known as citizen scientists. The unit of data collection is the pentad, five minutes of latitude by five minutes of longitude, squares with sides of roughly 9 km.

The initial list compiled for the species occurring in the QDS can however not be used as an accurate list in terms of the species actually occurring within the study area since it covers a larger area as well as a wider variety of habitats. In order to compile an accurate species list for the study area, all the species previously recorded in the 2528CD QDS were considered and added or eliminated on account of the habitat present on the study area as well as the habitat preferences of each of the species previously recorded within the larger QDS.

4.3 Threatened and Near Threatened bird species

By consulting the SABAP2 data basis, all the threatened and near threatened bird species previously recorded within the 2528CD QDS were added to the initial reference list of species that could potentially occur on or near the study area. All the threatened species occurring in or around the study area were reviewed (Roberts VII, Hockey *et al.* 2005; Taylor *et al.,* 2015*)* before conducting the field survey. During the field survey special attention was paid to identify any signs such as; actual sightings, suitable habitat, nest sites, suitable hunting/ foraging habitat or roosting spots pointing to the presence of these species.
A list was compiled to indicate the presence and/ or occurrence probability of bird species with conservation concerns based on the above mentioned indicators (**Table 2**).

4.4 Specific Requirements in terms of Red Data Avifaunal species

According to the Gauteng Department of Agriculture and Rural Development's (GDARD) requirements for Biodiversity Assessments, Version 3.3 (March 2014), as well as for any other Red Data species: Eleven threatened and near threatened bird species were prioritized for inclusion into the Gauteng C-Plan based on:

1. Threat status (2 Endangered **(EN),** 5 Vulnerable (**VU**) and 4 Near Threatened (**NT**)).
2. Whether the species was actually present, on a frequent basis, in the province. Vagrants, erratic visitors or erratic migrants to the province (Tarboton et al., 1987) have been excluded from the conservation plan.
3. Whether the threat was due to issues related to land use planning. Species which are impacted on mostly by threats such as poisoning were excluded.

Threatened Bird species regional conservation status (Taylor et al., 2015):

- Half-Collared Kingfisher (*Alcedo semitorquata*) **NT**
- Blue Crane (*Anthropoides paradiseus*) **NT**
- African Marsh-Harrier (*Circus ranivorus*) **EN**
- Blue Korhaan (*Eupodotis caerulescens*) **NT**
- White-bellied Korhaan (*Eupodotis senegalensis)* **VU**
- White-backed Night-Heron (*Gorsachius leuconotus*) **VU**
- Cape Vulture (*Gyps coprotheres*) **EN**
- Melodious Lark (*Mirafra cheniana*) **NT**
- African Finfoot (*Podica senegalensis*) **VU**
- Secretarybird (*Sagittarius serpentarius*) **VU**
- African Grass-Owl (*Tyto capensis*) **VU**

5. Results

5.1 Avifaunal Habitat Assessment:

During the habitat assessment eight distinct bird habitats were identified within the study area. These habitats are: Mixed Alien Vegetation, Mixed Residential and Agricultural, Near Natural Grassland, Riverine Vegetation, Rocky Ridge, Savanna Grassland, Urban Area and Wetland **Figure 4**). All the habitats identified on the study area are individually discussed hereafter.

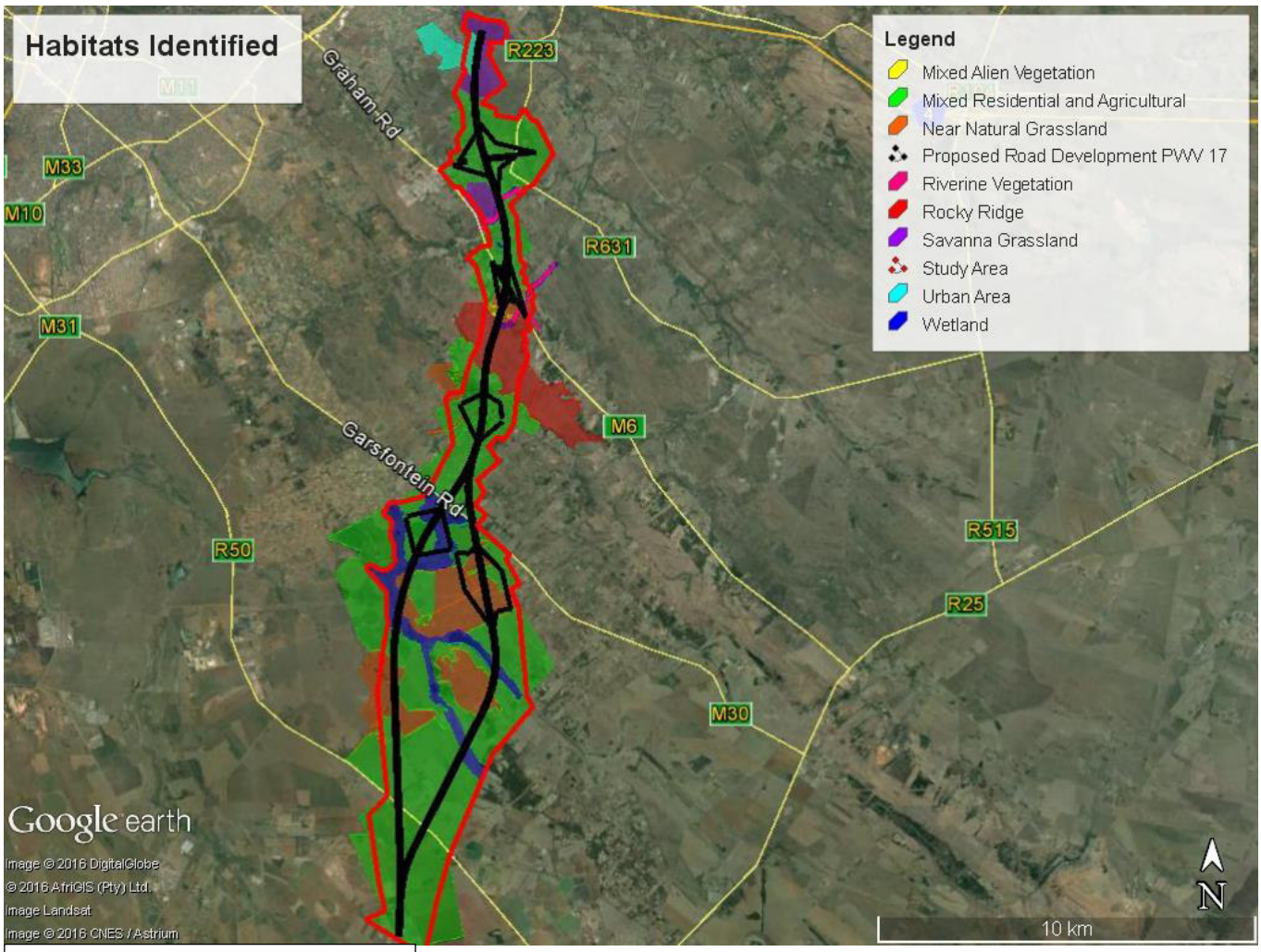

Figure 4: Habitats Identified

5.1.1 Urban Area:

This area contains various man-made disturbances associated with urban development. None of the natural occurring habitat remains (**Figure 5**). The reason for the inclusion of this area as a habitat in its own right is due to the large number of bird species that have adapted to this unique environment. Many of these species are widespread and common birds associated with urban gardens. No bird species with conservation concerns are expected to occur in this study unit. Species recorded in this area include Sparrows, Barbets, Doves, Pigeons and Indian Mynas. Many of these species are non-specialised and transient.

Figure 5: Urban Area

5.1.2 Mixed Alien Vegetation

This area contains various disturbances of which alien vegetation encroachment forms the main cause of the degraded state of this habitat. This study unit contains a large number of invasive plants including herbaceous weeds (*Zinnia peruviana* and *Tagetes minuta*) and alien trees (*Melia azedarach, Tipuana tipu*.) (**Figure 6**). As previously mentioned the reason for the inclusion of this area as a habitat in its own right is also due to the large number of bird species that have adapted to this pertubated environment. Many of these species are also non-specialised and transient. This study unit does contain a number of large indigenous trees such

as *Celtis africana, Searsia lancea* and *Vachellia karroo.* As a result of the occurrence of the aforementioned indigenous tree species, this habitat also houses avifaunal species such as Honeyguides, Brown-hooded Kingfisher (*Halcyon albiventris*), Yellow-fronted Tinkerbird (*Pogoniulus chrysoconus*), Olive Pigeon (*Columba arquatrix*) and Green Wood-hoopoe (*Phoeniculus purpureus*) associate with woodland habitats. On account of the large amount of alien vegetation encroachment and the lack of natural habitat this area was deemed to have a low avifaunal sensitivity as no bird species with conservation concerns are expected to occur.

Figure 6: Mixed Alien Vegetation Habitat

5.1.3 Mixed Residential and Agricultural

The largest part of the study area consists of this habitat type. As with the Urban and Mixed Alien Vegetation habitats a large number of bird species have adapted to this transformed habitat (**Figure 7**). This habitat is largely transformed due to agricultural activities and contains areas ranging from cultivated land to livestock farming as well as large open pastures. Species associated and adapted to this environment includes; Korhaan, Francolins, Spurfowl, Guinifowl, Ostrich, Cattle Egrets, Ibis, Storks, Pigeons, Chats and Starlings. Some of the properties in this study unit contain small dams where a variety of waterfowl and waders can be expected. Although this habitat might occasionally be utilized for foraging purposes by threatened and near threatened species such as Secretarybird (*Sagittarius serpentarius*), Blue Crane (*Anthropoides paradiseus*) and White-bellied Korhaan (*Eupodotis senegalensis*), no suitable breeding habitat for any threatened or near threatened avifaunal species were observed, as such the area cannot be deemed sensitive solely on account of the sporadic and occasional

presence of these IUCN Red listed bird species. Due to the agricultural zoning of most of the properties overlapping the study unit it is reasonable to anticipate that large open spaces will still be available for the purpose of foraging habitat for various bird species should the proposed road development take place. As a result of the lack of suitable breeding habitat for threatened and near threatened avifauna as well as the numerous disturbances associated with agricultural activities this habitat type was deemed to have a reasonably low avifaunal sensitivity.

Figure 7: Mixed Residential and Agricultural Habitat

5.1.4 Savanna Grassland

The Savanna Grassland study unit contains a large number of dense tree species dominated by *Vachellia karroo*, *Vachellia tortilis* and *Diospyros lycioides* interspersed with various grass species dominated by *Eragrostis spp*., *Heteropogon contortus* and *Themeda triandra* (**Figure 8**). This study unit support high bird densities and has an overall high species composition. Some of the bird species observed within this study unit includes; Chinspot Batis (*Batis molitor*), White-fronted Bee-eater (*Merops bullockoides*), Lizard Buzzard (*Kaupifalco monogrammicus*), Rattling Cisticola (*Cisticola chiniana*) and Black-shouldered Kite (*Elanus caeruleus*). The largest part of this study unit remains in a natural state with moderate connectivity to the east. The occurrence of threatened and near threatened bird species is questionable due to the various development and man-made activities in the surrounding areas. No suitable breeding habitat for any threatened bird species were observed on site, however the habitat might be suitable in terms of foraging and hunting for certain threatened species such as Lanner Falcon (*Falco biarmicus*). On account of the near natural state of the study unit together with the overall high

avifauna species composition, this study unit was deemed moderately sensitive from an avifaunal perspective.

Figure 8: Savanna Grassland

5.1.5 Near Natural Grassland

The Near Natural Grassland habitat contains mostly grass and forb vegetation (**Figure 9**). The majority of the near natural graasland habitat is situated on the southernmost section of the study area with the exeption of two small patches in the north. The habitat is dominates by *Eragrostis* spp., *Heteropogon contortus* and *Themeda triandra* grass species and by *Berkheya radula*, *Gerbera ambigua, Helichrysum nudifolium, Hilliardiella oligocephala, Ledebouria revoluta, Nemesia fruticans, Polygala amatymbica, Polygala hottentotta, Tephrosia capensis* and *Wahlenbergia caledonica* forb species. Grassland habitats normally have low to medium avifaunal species ritchnes as a result of the highly specialised environment. The habitat does provide the optimal foraging habitat for Seceratarybirds, known to be present in the area, as well as providing the preffered habitat for other threatened and near threatened avifauna species such as White-bellied Korhaan and Melodious Lark (*Mirafra cheniana*) and African Grassowls (*Tyto capensis*). As a result of the unique environment a number of habitat spacific species such as Anteating Chat (*Myrmecocichla formicivora*), Zitting Cisticola (*Cisticola juncidis*), Cape Longclaw (*Macronyx capensis*) and African Quailfinch (*Ortygospiza atricollis*) as wall as a few endemic species including; Cloud Cisticola (*Cisticola textrix*), Cape Grassbird

(*Sphenoeacus afer*) and South African Cliff-swallow (*Hirundo spilodera*) are present. Connectivity of the habitat unit with surrounding homogenous habitats is relatively good throughout the study area and to the east of the study area. On acount of the aforementioned conectivity function, optimal habitat for threatened bird species, natural state of the habitat and unique species composition the largest part of this habitat was deemed to be moderately senstive from a avifaunal perspective. One section of this habitat unit was deemed to be highly sensitive as it is located between two highly sensitive wetland sections and connects two of the three near natural grassland habitast in the southern portion of the study area. This highly sensitive section of the near natural grassland also provides the optimal breeding and foraging habitat for Grassowls.

Figure 9: Near Natural Grassland

5.1.6 Rocky Ridge

The Rocky ridge habitat unit is situated in the middle of the study area between Graham Road and Garsfontein Road. This habitat comprises of mixed rocky grassland dominated by *Aristida junciformis* and *Melines repens* and rocky woodland dominated by *Diospyros lycioides, Searsia lancea, Searsia magalismontana* and *Vangueria infausta* (**Figure 10**). The ridge is commonly known as Bronberg and is classified as a class 2 ridge which includes ridges of which more than 5%, but less than 35%, of their surface area has been converted to urban development, quarries and/or alien vegetation. The implications of the classification of this study unit's as a Class 2 ridge is stipulated in the Gauteng Ridge Police of 2001. This habitat is in a pristine

natural condition and provides the optimal habitat for numerous habitat bound bird species such as Mocking Cliff-chat (*Thamnolaea cinnamomeiventris*), Mountain Wheatear (*Oenanthe monticola*), Cape Rock-thrush (*Monticola rupestris*), Lazy Cisticola (*Cisticola aberrans*) and Cinnamon-breasted Bunting (*Emberiza tahapisi*). The habitat does not necessarily provide the preferred habitat for threatened bird species, however it does provide the optimal habitat for ridge bound bird species. In terms of avifauna this habitat unit plays a critical connectivity role as it forms part of the larger 2200 ha Bronberg ridge which is already isolated from similar ridges in the surrounding area. The habitat was found to have a high avifaunal species richness as well as a high species density. Of the 106 bird species observed during the field assessment 37 were present in this habitat. No threatened bird species were observed or are expected to be resident within this study unit.
On account of the pristine natural avifaunal habitat and the critical connectivity function fulfilled by this study unit the habitat was deemed to be highly sensitive from an avifaunal perspective.

Figure 10: Rocky Ridge Habitat

5.1.7 Wetland

The larger study area contains a number of scattered wetlands some of which forms part of surrounding rivers and streams and some forming part of man-mad dams and natural drainage

lines and seepage area. The largest wetland is situated on the southern section of the study area and contains one big dam and a few smaller dams connected by vast stretches of natural wetlands. This habitat is dominated by palustrine vegetation such as *Cypress spp., Schoenoplectus spp.* and *Typha capensis* as well as other wetland associated vegetation (**Figure 11**). This habitat unit contains very little trees; however scattered indigenous and alien trees are present throughout the wetland areas as well as some dense tree and shrub stands where small streams connect different sections of the wetland network. The wetland habitat provides the preferred habitat for large number of bird species including Ralids, Ducks, Herons, Kingfishers, Cormorants, Waders and Warblers. 63 bird species were recorded within this habitat unit. Nine threatened bird species are expected to occur within this habitat unit namely; African Marsh Harrier, Blue Crane (*Anthropoides paradiseus*), Lesser and Greater Flamingo (*Phoenicopterus sp.*), Maccoa Duck (*Oxyura maccoa*), Half-collared Kingfisher (*Alcedo semitorquata*), African Grass-owl (*Tyto capensis*), Black-wing Pratnincole (*Glareola nordmanni*) and Caspian Tern (*Sterna caspia*). Of the aforementioned threatened bird species four (African Marsh Harrier (*Circus ranivorus)*, Blue Crane, Half-collared Kingfisher and African Grass-owl) are prioritized in the Gauteng C plan version 3.3. The wetland habitat provides the ideal breeding habitat for African Marsh-harrier, Blue Crane and African Grass-owl. The scattered dams in-between wetland sections provides the preferred foraging habitat for both Greater and Lesser flamingos, Caspian Tern and Black-winged Pratnincole as well as providing optimal breeding habitat for Half-collared Kingfisher and Maccoa Duck. The wetland habitat is largely intact apart from some man-made and agricultural disturbances such as dam walls and recreational use activities. In terms of habitat connectivity this study unit forms part of a largely undisturbed and well connected wetland network of approximately 490 ha.

As a result of the intact and undisturbed nature of the wetland habitat along with the optimal habitat it provides for a number of threatened and near threatened bird species this study unit was deemed highly sensitive from an avifaunal standpoint.

Figure 11: Wetland

5.1.8 Riverine Vegetation

The riverine vegetation habitat unit is located at the sections where the proposed road development intersects the Zwavelpoort spruit and Pienaars River. Both of the aforementioned watercourses are classified as perennial rivers. This habitat is densely vegetated and contains a number of riparian trees, shrubs and grasses (**Figure 12**). The riverine habitat is dominated by large trees such as *Celtis africana*, *Combretum erythrophyllum*, *Vachellia karroo* and grasses including; *Imperata cylindrical*, *Typha capensis*, and *Phragmites australis.* As a result of the vegetation diversity as well as the dense nature of the riverine vegetation the habitat supports a large avifaunal density and diversity. Species observed within this habitat unit includes; Kingfishers, Moorhen, Weavers, Bishops, Ibis, Herons and Ducks. The riverine habitat provides the prime breeding habitat for the near threatened Half-collared Kingfisher in that it contains stretches of fast flowing water with vertical bank along with over-hanging dense vegetation. No other threatened bird species are expected to occur within the riverine habitat.

Although some disturbances in the form of berms, extraction, recreational use and alien vegetation encroachment along the both watercourses are evident, connectivity to homogeneous habitats are very good which promotes the movement of species.

Due to the connectivity function, high avifaunal diversity and optimal habitat for the near threatened Half-collared Kingfisher this habitat unit was deemed to be highly sensitive.

Figure 12: Riverine Vegetation

Table 1: Bird species observed within the study area during the field survey, as well as bird species potentially occurring on the study area as a result of habitat preferences and previous records.

The biodiversity index indicates the probability of a species breeding (BR) within the study area as well as the occurrence probability within the study area according to the habitat preferences (HP) of that specific species. Very Low – 1, Low – 2, Medium – 3, High – 4, Recorded on site – 5, Not likely to occur/breed – 0, Threatened Species

	Species name	Afrikaans	*Taxonomic name*	Rep Rate %	OP	BR
1.	Apalis, Bar-throated	Bandkeelkleinjantjie	*Apalis thoracica*	12.355	4	4
2.	Avocet, Pied	Bontelsie	*Recurvirostra avosetta*	0.095	3	2
3.	Babbler, Arrow-marked	Pylvlekkatlagter	*Turdoides jardineii*	24.69	4	4
4.	Barbet, Acacia Pied	Bonthoutkapper	*Tricholaema leucomelas*	16.08	4	4
5.	Barbet, Black-collared	Rooikophoutkapper	*Lybius torquatus*	70.135	5	4
6.	Barbet, Crested	Kuifkophoutkapper	*Trachyphonus vaillantii*	90.2	5	4
7.	Batis, Chinspot	Witliesbosbontrokkie	*Batis molitor*	17.31	5	4
8.	Bee-eater, European	Europese Byvreter	*Merops apiaster*	17.585	5	0
9.	Bee-eater, Little	Kleinbyvreter	*Merops pusillus*	1.495	3	3
10.	Bee-eater, White-fronted	Rooikeelbyvreter	*Merops bullockoides*	25.595	5	4
11.	Bishop, Southern Red	Rooivink	*Euplectes orix*	62.005	5	5
12.	Bishop, Yellow-crowned	Goudgeelvink	*Euplectes afer*	19.31	5	4
13.	Bittern, Little	Kleinrietreier (Woudapie)	*Ixobrychus minutus*	0.935	3	3
14.	Bokmakierie, Bokmakierie	Bokmakierie	*Telophorus zeylonus*	60.215	5	4
15.	Boubou, Southern	Suidelike Waterfiskaal	*Laniarius ferrugineus*	50.27	5	4

16.	Brubru, Brubru	Bontroklaksman	*Nilaus afer*	4.4	3	3
17.	Bulbul, Dark-capped	Swartoogtiptol	*Pycnonotus tricolor*	93.355	5	4
18.	Bunting, Cape	Rooivlerkstreepkoppie	*Emberiza capensis*	1.885	3	3
19.	Bunting, Cinnamon-breasted	Klipstreepkoppie	*Emberiza tahapisi*	6.735	4	4
20.	Bunting, Golden-breasted	Rooirugstreepkoppie	*Emberiza flaviventris*	0.47	2	2
21.	Bunting, Lark-like	Vaalstreepkoppie	*Emberiza impetuani*	0.095	2	2
22.	Bush-shrike, Grey-headed	Spookvoel	*Malaconotus blanchoti*	2.375	4	4
23.	Buttonquail, Kurrichane	Bosveldkwarteltjie	*Turnix sylvaticus*	0.28	4	4
24.	Buzzard, Lizard	Akkedisvalk	*Kaupifalco monogrammicus*	0.185	5	3
25.	Buzzard, Steppe	Bruinjakkalsvoel	*Buteo vulpinus*	12.06	4	0
26.	Canary, Black-throated	Bergkanarie	*Crithagra atrogularis*	44.24	5	4
27.	Canary, Yellow-fronted	Geeloogkanarie	*Crithagra mozambicus*	33.72	5	4
28.	Chat, Anteating	Swartpiek	*Myrmecocichla formicivora*	6.205	5	4
29.	Chat, Familiar	Gewone Spekvreter	*Cercomela familiaris*	6.695	4	4
30.	Cisticola, Cloud	Gevlekte Klopkloppie	*Cisticola textrix*	13.215	5	4
31.	Cisticola, Desert	Woestynklopkloppie	*Cisticola aridulus*	7.875	5	4
32.	Cisticola, Lazy	Luitinktinkie	*Cisticola aberrans*	3.365	4	4
33.	Cisticola, Levaillant's	Vleitinktinkie	*Cisticola tinniens*	43.805	5	5
34.	Cisticola, Rattling	Bosveldtinktinkie	*Cisticola chiniana*	5.05	5	4
35.	Cisticola, Wailing	Huiltinktinkie	*Cisticola lais*	6.425	3	3
36.	Cisticola, Wing-snapping	Kleinste Klopkloppie	*Cisticola ayresii*	12.56	4	4
37.	Cisticola, Zitting	Landeryklopkloppie	*Cisticola juncidis*	25.805	5	5

38.	Cliff-chat, Mocking	Dassievoel	*Thamnolaea cinnamomeiventris*	4.96	3	3
39.	Cliff-swallow, South African	Familieswael	*Hirundo spilodera*	6.775	5	4
40.	Coot, Red-knobbed	Bleshoender	*Fulica cristata*	44.485	5	5
41.	Cormorant, Reed	Rietduiker	*Phalacrocorax africanus*	51.635	5	3
42.	Cormorant, White-breasted	Witborsduiker	*Phalacrocorax carbo*	15.25	5	2
43.	Coucal, Burchell's	Gewone Vleiloerie	*Centropus burchellii*	37.93	4	4
44.	Courser, Temminck's	Trekdrawwertjie	*Cursorius temminckii*	2.095	3	3
45.	Crake, Black	Swartriethaan	*Amaurornis flavirostris*	11.685	5	4
46.	Crane, Blue	Bloukraanvoel	*Anthropoides paradiseus*	3.585	3	2
47.	Crombec, Long-billed	Bosveldstompstert	*Sylvietta rufescens*	9.92	4	4
48.	Crow, Pied	Witborskraai	*Corvus albus*	60.1	5	4
49.	Cuckoo, Black	Swartkoekoek	*Cuculus clamosus*	14.055	4	4
50.	Cuckoo, Diderick	Diederikkie	*Chrysococcyx caprius*	36.455	4	4
51.	Cuckoo, Klaas's	Meitjie	*Chrysococcyx klaas*	5.27	4	4
52.	Cuckoo, Levaillant's	Gestreepte Nuwejaarsvoel	Clamator levaillantii	4.26	3	3
53.	Cuckoo, Red-chested	Piet-my-vrou	*Cuculus solitarius*	28.265	4	4
54.	Cuckoo-shrike, Black	Swartkatakoeroe	*Campephaga flava*	5.08	3	3
55.	Darter, African	Slanghalsvoel	*Anhinga rufa*	16.76	5	4
56.	Dove, Laughing	Rooiborsduifie	*Streptopelia senegalensis*	98.22	5	5
57.	Dove, Namaqua	Namakwaduifie	*Oena capensis*	1.31	4	4

58.	Dove, Red-eyed	Grootringduif	*Streptopelia semitorquata*	52.86	5	4
59.	Dove, Rock	Tuinduif	*Columba livia*	33.635	4	4
60.	Drongo, Fork-tailed	Mikstertbyvanger	*Dicrurus adsimilis*	33.305	4	4
61.	Duck, African Black	Swarteend	*Anas sparsa*	14.63	5	4
62.	Duck, Comb	Knobbeleend	*Sarkidiornis melanotos*	3.925	2	2
63.	Duck, Fulvous	Fluiteend	*Dendrocygna bicolor*	2.375	2	2
64.	Duck, Maccoa	Bloubekeend	*Oxyura maccoa*	4.935	3	3
65.	Duck, Mallard	Groenkopeend	*Anas platyrhynchos*	5.14	2	2
66.	Duck, White-backed	Witrugeend	*Thalassornis leuconotus*	4.095	2	2
67.	Duck, White-faced	Nonnetjie-eend	*Dendrocygna viduata*	16.68	4	4
68.	Duck, Yellow-billed	Geelbekeend	*Anas undulata*	43.96	5	4
69.	Eagle, Tawny	Roofarend	*Aquila rapax*	0.095	1	0
70.	Eagle, Verreaux's	Witkruisarend	*Aquila verreauxii*	1.135	1	0
71.	Eagle, Wahlberg's	Bruinarend	*Aquila wahlbergi*	0.47	5	1
72.	Eagle-owl, Spotted	Gevlekte Ooruil	*Bubo africanus*	11.135	4	4
73.	Egret, Cattle	Veereier	*Bubulcus ibis*	83.735	5	4
74.	Egret, Great	Grootwitreier	*Egretta alba*	3.405	3	3
75.	Egret, Little	Kleinwitreier	*Egretta garzetta*	12.965	4	3
76.	Egret, Yellow-billed	Geelbekwitreier	*Egretta intermedia*	4.845	3	2
77.	Falcon, Amur	Oostelike Rooipootvalk	*Falco amurensis*	14.47	5	0
78.	Falcon, Lanner	Edelvalk	*Falco biarmicus*	4.47	3	0
79.	Falcon, Peregrine	Swerfvalk	*Falco peregrinus*	0.095	2	0

80.	Falcon, Red-footed	Westelike Rooipootvalk	*Falco vespertinus*	0.185	2	0
81.	Finch, Cuckoo	Koekoekvink	*Anomalospiza imberbis*	1.415	2	2
82.	Finch, Cut-throat	Bandkeelvink	*Amadina fasciata*	3.74	4	4
83.	Finch, Red-headed	Rooikopvink	*Amadina erythrocephala*	8.32	4	4
84.	Finch, Scaly-feathered	Baardmannetjie	*Sporopipes squamifrons*	1.585	2	2
85.	Firefinch, African	Kaapse Vuurvinkie	*Lagonosticta rubricata*	2.15	2	2
86.	Firefinch, Jameson's	Jamesonse Vuurvinkie	*Lagonosticta rhodopareia*	8.975	4	4
87.	Firefinch, Red-billed	Rooibekvuurvinkie	*Lagonosticta senegala*	3.405	4	4
88.	Fiscal, Common (Southern)	Fiskaallaksman	*Lanius collaris*	96.35	5	4
89.	Fish-eagle, African	Visarend	*Haliaeetus vocifer*	7.2	5	4
90.	Flamingo, Greater	Grootflamink	*Phoenicopterus ruber*	4.095	4	0
91.	Flamingo, Lesser	Kleinflamink	*Phoenicopterus minor*	2	2	0
92.	Flufftail, Red-chested	Rooiborsvleikuiken	*Sarothrura rufa*	6.28	5	4
93.	Flycatcher, Fairy	Feevlieievanger	*Stenostira scita*	2.53	3	3
94.	Flycatcher, Fiscal	Fiskaalvlieivanger	*Sigelus silens*	38.66	4	4
95.	Flycatcher, Marico	Maricovlieevanger	*Bradornis mariquensis*	1.31	3	3
96.	Flycatcher, Pale	Muiskleurvlieevanger	*Bradornis pallidus*	1.04	2	2
97.	Flycatcher, Southern Black	Swartvlieevanger	*Melaenornis pammelaina*	6.335	4	4
98.	Flycatcher, Spotted	Europese Vlieievanger	*Muscicapa striata*	12.155	4	0
99.	Francolin, Coqui	Swempie	*Peliperdix coqui*	8.3	4	4

100.	Francolin, Crested	Bospatrys	*Dendroperdix sephaena*	0.56	3	3
101.	Francolin, Orange River	Kalaharipatrys	*Scleroptila levaillantoides*	2.095	4	4
102.	Francolin, Red-winged	Rooivlerkpatrys	*Scleroptila levaillantii*	2.74	3	3
103.	Francolin, Shelley's	Laeveldpatrys	*Scleroptila shelleyi*	0.375	2	2
104.	Go-away-bird, Grey	Kwêvoel	*Corythaixoides concolor*	73.27	5	4
105.	Goose, Egyptian	Kolgans	*Alopochen aegyptiacus*	44.48	5	4
106.	Goose, Spur-winged	Wildemakou	*Plectropterus gambensis*	12.155	5	4
107.	Goshawk, Gabar	Kleinsingvalk	*Melierax gabar*	2.27	4	4
108.	Grass-owl, African	Grasuil	*Tyto capensis*	0.655	1	0
109.	Grassbird, Cape	Grasvoel	*Sphenoeacus afer*	32.585	4	4
110.	Grebe, Great Crested	Kuifkopdobbertjie	*Podiceps cristatus*	13.805	5	4
111.	Grebe, Little	Kleindobbertjie	*Tachybaptus ruficollis*	40.395	5	4
112.	Green-pigeon, African	Papegaaiduif	*Treron calvus*	2.46	3	3
113.	Greenshank, Common	Groenpootruiter	*Tringa nebularia*	2.56	4	0
114.	Guineafowl, Helmeted	Gewone Tarentaal	*Numida meleagris*	70.82	5	4
115.	Gull, Grey-headed	Gryskopmeeu	*Larus cirrocephalus*	17.43	5	4
116.	Hamerkop, Hamerkop	Hamerkop	*Scopus umbretta*	21.545	4	4
117.	Harrier, Pallid	Witborsvleivalk	*Circus macrourus*	2	1	0
118.	Harrier-Hawk, African	Kaalwangvalk	*Polyboroides typus*	0.84	3	2
119.	Heron, Black	Swartreier	*Egretta ardesiaca*	2.095	5	3
120.	Heron, Black-headed	Swartkopreier	*Ardea melanocephala*	54.665	5	4

121.	Heron, Goliath	Reusereier	*Ardea goliath*	2.52	3	3
122.	Heron, Green-backed	Groenrugreier	*Butorides striata*	6.41	3	3
123.	Heron, Grey	Bloureier	*Ardea cinerea*	21.615	4	3
124.	Heron, Purple	Rooireier	*Ardea purpurea*	14.435	4	3
125.	Heron, Squacco	Ralreier	*Ardeola ralloides*	1.6	4	3
126.	Honey-buzzard, European	Wespedief	*Pernis apivorus*	2.085	1	0
127.	Honeybird, Brown-backed	Skerpbekheuningvoel	*Prodotiscus regulus*	2.555	2	2
128.	Honeyguide, Greater	Grootheuningwyser	*Indicator indicator*	1.78	3	3
129.	Honeyguide, Lesser	Kleinheuningwyser	*Indicator minor*	10.185	4	4
130.	Hoopoe, African	Hoephoep	*Upupa africana*	65.31	4	4
131.	Hornbill, African Grey	Grysneushoringvoel	*Tockus nasutus*	24.12	4	4
132.	Hornbill, Red-billed	Rooibekneushoringvoel	*Tockus erythrorhynchus*	4.165	1	1
133.	Hornbill, Southern Yellow-billed	Geelbekneushoringvoel	*Tockus leucomelas*	2.365	1	1
134.	House-martin, Common	Huisswael	*Delichon urbicum*	5.78	3	1
135.	Ibis, African Sacred	Skoorsteenveer	*Threskiornis aethiopicus*	63.75	5	2
136.	Ibis, Glossy	Glansibis	*Plegadis falcinellus*	35.055	5	3
137.	Ibis, Hadeda	Hadeda	*Bostrychia hagedash*	92.515	5	4
138.	Indigobird, Purple	Witpootblouvinkie	*Vidua purpurascens*	2.805	2	2
139.	Indigobird, Village	Staalblouvinkie	*Vidua chalybeata*	0.935	2	2
140.	Jacana, African	Grootlangtoon	*Actophilornis africanus*	1.225	3	3
141.	Kestrel, Greater	Grootrooivalk	*Falco rupicoloides*	2.35	2	2

142.	Kestrel, Lesser	Kleinrooivalk	*Falco naumanni*	0.28	2	0
143.	Kestrel, Rock	Kransvalk	*Falco rupicolus*	0.56	3	1
144.	Kingfisher, Brown-hooded	Bruinkopvisvanger	*Halcyon albiventris*	30.86	5	4
145.	Kingfisher, Giant	Reusevisvanger	*Megaceryle maximus*	8.78	4	4
146.	Kingfisher, Half-collared	Blouvisvanger	*Alcedo semitorquata*	1.135	3	3
147.	Kingfisher, Malachite	Kuifkopvisvanger	*Alcedo cristata*	7.37	5	4
148.	Kingfisher, Pied	Bontvisvanger	*Ceryle rudis*	18.805	4	4
149.	Kingfisher, Woodland	Bosveldvisvanger	*Halcyon senegalensis*	10.565	4	4
150.	Kite, Black	Swartwou	*Milvus migrans*	2.06	1	0
151.	Kite, Black-shouldered	Blouvalk	*Elanus caeruleus*	61.875	5	4
152.	Kite, Yellow-billed	Geelbekwou	*Milvus aegyptius*	6.835	3	0
153.	Korhaan, Blue	Bloukorhaan	*Eupodotis caerulescens*	0.185	2	2
154.	Korhaan, Northern Black	Witvlerkkorhaan	*Afrotis afraoides*	17.09	5	4
155.	Korhaan, White-bellied	Witpenskorhaan	*Eupodotis senegalensis*	0.095	2	2
156.	Lapwing, African Wattled	Lelkiewiet	*Vanellus senegallus*	39.585	4	4
157.	Lapwing, Blacksmith	Bontkiewiet	*Vanellus armatus*	67.38	5	4
158.	Lapwing, Crowned	Kroonkiewiet	*Vanellus coronatus*	89.98	5	4
159.	Lark, Dusky	Donkerlewerik	*Pinarocorys nigricans*	0.465	1	1
160.	Lark, Eastern Clapper	Hoeveldklappertjie	*Mirafra fasciolata*	0.845	3	3
161.	Lark, Melodious	Spotlewerik	*Mirafra cheniana*	0.935	1	1
162.	Lark, Monotonous	Bosveldlewerik	*Mirafra passerina*	0.28	1	1
163.	Lark, Red-capped	Rooikoplewerik	*Calandrella cinerea*	12.75	4	4

164.	Lark, Rufous-naped	Rooineklewerik	*Mirafra africana*	23.77	4	4
165.	Lark, Sabota	Sabotalewerik	*Calendulauda sabota*	2.56	3	3
166.	Lark, Spike-heeled	Vlaktelewerik	*Chersomanes albofasciata*	4.28	4	4
167.	Longclaw, Cape	Oranjekeelkalkoentjie	*Macronyx capensis*	47.925	5	4
168.	Mannikin, Bronze	Gewone Fret	*Spermestes cucullatus*	38.065	5	4
169.	Marsh-Harrier, African	Afrikaanse Vleivalk	*Circus ranivorus*	0	3	3
170.	Martin, Banded	Gebande Oewerswael	*Riparia cincta*	9.78	5	4
171.	Martin, Brown-throated	Afrikaanse Oewerswael	*Riparia paludicola*	11.65	5	4
172.	Martin, Rock	Kransswael	*Hirundo fuligula*	9.825	5	4
173.	Martin, Sand	Europese Oewerswael	*Riparia riparia*	0.56	1	0
174.	Masked-weaver, Lesser	Kleingeelvink	*Ploceus intermedius*	2.055	2	2
175.	Masked-weaver, Southern	Swartkeelgeelvink	*Ploceus velatus*	89.855	5	5
176.	Moorhen, Common	Grootwaterhoender	*Gallinula chloropus*	23.715	5	4
177.	Moorhen, Lesser	Kleinwaterhoender	*Gallinula angulata*	2	1	0
178.	Mousebird, Red-faced	Rooiwangmuisvoel	*Urocolius indicus*	47.135	5	4
179.	Mousebird, Speckled	Gevlekte Muisvoel	*Colius striatus*	76.065	5	4
180.	Mousebird, White-backed	Witkruismuisvoel	*Colius colius*	1.5	1	1
181.	Myna, Common	Indiese Spreeu	*Acridotheres tristis*	46.925	5	4
182.	Neddicky, Neddicky	Neddikkie	*Cisticola fulvicapilla*	34.23	5	4
183.	Night-Heron, Black-crowned	Gewone Nagreier	*Nycticorax nycticorax*	1.31	4	4
184.	Nightjar, European	Europese Naguil	*Caprimulgus europaeus*	0.47	1	0

185.	Nightjar, Fiery-necked	Afrikaanse Naguil	*Caprimulgus pectoralis*	8.415	3	3
186.	Nightjar, Freckled	Donkernaguil	*Caprimulgus tristigma*	0.655	1	1
187.	Nightjar, Rufous-cheeked	Rooiwangnaguil	*Caprimulgus rufigena*	0.185	1	1
188.	Olive-pigeon, African	Geelbekbosduif	*Columba arquatrix*	0.745	3	3
189.	Oriole, Black-headed	Swartkopwielewaal	*Oriolus larvatus*	19.83	4	4
190.	Ostrich, Common	Volstruis	*Struthio camelus*	25.275	5	4
191.	Owl, Barn	Nonnetjie-uil	*Tyto alba*	4.77	4	4
192.	Owl, Marsh	Vlei-uil	*Asio capensis*	9.31	5	4
193.	Owlet, Pearl-spotted	Witkoluil	*Glaucidium perlatum*	0.47	1	1
194.	Painted-snipe, Greater	Goudsnip	*Rostratula benghalensis*	0.095	1	0
195.	Palm-swift, African	Palmwindswael	*Cypsiurus parvus*	36.655	5	4
196.	Paradise-flycatcher, African	Paradysvlieevanger	*Terpsiphone viridis*	21.08	4	4
197.	Paradise-whydah, Long-tailed	Gewone Paradysvink	*Vidua paradisaea*	3.37	3	3
198.	Peacock, Common	Makpou	*Pavo cristatus*	2	2	2
199.	Penduline-tit, Cape	Kaapse Kapokvoel	*Anthoscopus minutus*	0.095	1	1
200.	Petronia, Yellow-throated	Geelvlekmossie	*Petronia superciliaris*	2.365	1	1
201.	Pigeon, Speckled	Kransduif	*Columba guinea*	68.65	5	4
202.	Pipit, African	Gewone Koester	*Anthus cinnamomeus*	41.935	5	4
203.	Pipit, Buffy	Vaalkoester	*Anthus vaalensis*	2.185	2	2
204.	Pipit, Bushveld	Bosveldkoester	*Anthus caffer*	0.095	1	1
205.	Pipit, Long-billed	Nicholsonse Koester	*Anthus similis*	0.655	1	1

206.	Pipit, Plain-backed	Donkerkoester	*Anthus leucophrys*	1.04	2	2
207.	Pipit, Striped	Gestreepte Koester	*Anthus lineiventris*	0.375	3	3
208.	Plover, Common Ringed	Ringnekstrandkiewiet	*Charadrius hiaticula*	2.185	1	1
209.	Plover, Kittlitz's	Geelborsstrandkiewiet	*Charadrius pecuarius*	4.28	2	2
210.	Plover, Three-banded	Driebandstrandkiewiet	*Charadrius tricollaris*	19.305	5	4
211.	Pochard, Southern	Bruineend	*Netta erythrophthalma*	7.59	4	4
212.	Pratincole, Black-winged	Swartvlerksprinkaanvoel	*Glareola nordmanni*	4.185	2	0
213.	Prinia, Black-chested	Swartbandlangstertjie	*Prinia flavicans*	38.54	5	4
214.	Prinia, Tawny-flanked	Bruinsylangstertjie	*Prinia subflava*	53.605	5	4
215.	Puffback, Black-backed	Sneeubal	*Dryoscopus cubla*	19.08	4	4
216.	Pytilia, Green-winged	Gewone Melba	*Pytilia melba*	2.47	4	4
217.	Quail, Common	Afrikaanse Kwartel	*Coturnix coturnix*	6.185	4	4
218.	Quailfinch, African	Gewone Kwartelvinkie	*Ortygospiza atricollis*	26.245	5	4
219.	Quelea, Red-billed	Rooibekkwelea	*Quelea quelea*	30.245	5	4
220.	Rail, African	Grootriethaan	*Rallus caerulescens*	6.095	4	4
221.	Reed-warbler, African	Kleinrietsanger	*Acrocephalus baeticatus*	6.935	4	4
222.	Reed-warbler, Great	Grootrietsanger	*Acrocephalus arundinaceus*	0.28	3	0
223.	Robin-chat, Cape	Gewone Janfrederik	*Cossypha caffra*	76.245	5	4
224.	Robin-chat, White-throated	Witkeeljanfrederik	*Cossypha humeralis*	4.59	3	3
225.	Rock-thrush, Cape	Kaapse Kliplyster	*Monticola rupestris*	0.75	4	4
226.	Roller, Lilac-breasted	Gewone Troupant	*Coracias caudatus*	0.28	1	1
227.	Roller, Purple	Groottroupant	*Coracias naevius*	0.185	1	1

228.	Ruff, Ruff	Kemphaan	*Philomachus pugnax*	2.47	3	0
229.	Rush-warbler, Little	Kaapse Vleisanger	*Bradypterus baboecala*	11.965	5	4
230.	Sandpiper, Common	Gewone Ruiter	*Actitis hypoleucos*	3.195	4	0
231.	Sandpiper, Curlew	Krombekstrandloper	*Calidris ferruginea*	2.185	1	0
232.	Sandpiper, Marsh	Moerasruiter	*Tringa stagnatilis*	2.75	3	0
233.	Sandpiper, Wood	Bosruiter	*Tringa glareola*	9.78	4	0
234.	Scimitarbill, Common	Swartbekkakelaar	*Rhinopomastus cyanomelas*	7.525	4	4
235.	Scops-owl, Southern White-faced	Witwanguil	*Ptilopsus granti*	0.095	1	1
236.	Scrub-robin, Kalahari	Kalahariwipstert	*Cercotrichas paena*	0.375	2	2
237.	Scrub-robin, White-browed	Gestreepte Wipstert	*Cercotrichas leucophrys*	7.765	4	4
238.	Secretarybird,	Sekretarisvoel	*Sagittarius serpentarius*	3.125	3	1
239.	Seedeater, Streaky-headed	Streepkopkanarie	*Crithagra gularis*	30.865	5	4
240.	Shelduck, South African	Kopereend	*Tadorna cana*	4	4	4
241.	Shikra, Shikra	Gebande Sperwer	*Accipiter badius*	0.845	1	1
242.	Shoveler, Cape	Kaapse Slopeend	*Anas smithii*	10.715	4	4
243.	Shrike, Crimson-breasted	Rooiborslaksman	*Laniarius atrococcineus*	11.035	3	3
244.	Shrike, Lesser Grey	Gryslaksman	*Lanius minor*	2.655	3	0
245.	Shrike, Magpie	Langstertlaksman	*Corvinella melanoleuca*	2.805	2	2
246.	Shrike, Red-backed	Rooiruglaksman	*Lanius collurio*	3.125	4	0
247.	Snake-eagle, Black-	Swartborsslangarend	*Circaetus pectoralis*	4.35	5	2

	chested					
248.	Snipe, African	Afrikaanse Snip	*Gallinago nigripennis*	12.375	5	4
249.	Sparrow, Cape	Gewone Mossie	*Passer melanurus*	90.44	5	5
250.	Sparrow, House	Huismossie	*Passer domesticus*	53.62	5	5
251.	Sparrow, Southern Grey-headed	Gryskopmossie	*Passer diffusus*	49.275	5	4
252.	Sparrow-weaver, White-browed	Koringvoel	*Plocepasser mahali*	12.475	4	4
253.	Sparrowhawk, Black	Swartsperwer	*Accipiter melanoleucus*	2.75	3	3
254.	Sparrowhawk, Little	Kleinsperwer	*Accipiter minullus*	2.46	3	3
255.	Sparrowhawk, Ovambo	Ovambosperwer	*Accipiter ovampensis*	5.01	4	4
256.	Sparrowlark, Chestnut-backed	Rooiruglewerik	*Eremopterix leucotis*	2.185	2	2
257.	Spoonbill, African	Lepelaar	*Platalea alba*	11.685	5	2
258.	Spurfowl, Natal	Natalse Fisant	*Pternistis natalensis*	0.65	2	2
259.	Spurfowl, Swainson's	Bosveldfisant	*Pternistis swainsonii*	41.55	5	4
260.	Starling, Cape Glossy	Kleinglansspreeu	*Lamprotornis nitens*	55.875	5	4
261.	Starling, Pied	Witgatspreeu	*Spreo bicolor*	13.84	4	4
262.	Starling, Red-winged	Rooivlerkspreeu	*Onychognathus morio*	8.87	4	4
263.	Starling, Violet-backed	Witborsspreeu	*Cinnyricinclus leucogaster*	5.655	4	4
264.	Starling, Wattled	Lelspreeu	*Creatophora cinerea*	4.185	3	3
265.	Stilt, Black-winged	Rooipootelsie	*Himantopus himantopus*	2.935	4	3
266.	Stint, Little	Kleinstrandloper	*Calidris minuta*	2.75	3	0
267.	Stonechat, African	Gewone Bontrokkie	*Saxicola torquatus*	51.83	5	4

268.	Stork, Abdim's	Kleinswartooievaar	*Ciconia abdimii*	1.125	3	0
269.	Stork, Black	Grootswartooievaar	*Ciconia nigra*	0.185	1	0
270.	Stork, White	Witooievaar	*Ciconia ciconia*	2.525	4	0
271.	Sunbird, Amethyst	Swartsuikerbekkie	*Chalcomitra amethystina*	48.455	5	4
272.	Sunbird, Malachite	Jangroentjie	*Nectarinia famosa*	1.695	1	1
273.	Sunbird, Marico	Maricosuikerbekkie	*Cinnyris mariquensis*	0.845	2	2
274.	Sunbird, White-bellied	Witpenssuikerbekkie	*Cinnyris talatala*	65.105	5	4
275.	Swallow, Barn	Europese Swael	*Hirundo rustica*	33.58	4	0
276.	Swallow, Greater Striped	Grootstreepswael	*Hirundo cucullata*	50.505	5	4
277.	Swallow, Lesser Striped	Kleinstreepswael	*Hirundo abyssinica*	27.325	5	4
278.	Swallow, Pearl-breasted	PiAÂ¿AÂ½relborsswael	*Hirundo dimidiata*	5.03	3	3
279.	Swallow, Red-breasted	Rooiborsswael	*Hirundo semirufa*	5.8	4	4
280.	Swallow, White-throated	Witkeelswael	*Hirundo albigularis*	27.705	5	4
281.	Swamp-warbler, Lesser	Kaapse Rietsanger	*Acrocephalus gracilirostris*	14.495	5	4
282.	Swamphen, African Purple	Grootkoningriethaan	*Porphyrio madagascariensis*	2.895	4	4
283.	Swift, African Black	Swartwindswael	*Apus barbatus*	1.685	2	1
284.	Swift, Alpine	Witpenswindswael	*Tachymarptis melba*	1.12	2	1
285.	Swift, Common	Europese Windswael	*Apus apus*	2.28	2	0
286.	Swift, Horus	Horuswindswael	*Apus horus*	6.175	4	2
287.	Swift, Little	Kleinwindswael	*Apus affinis*	34.705	5	4
288.	Swift, White-rumped	Witkruiswindswael	*Apus caffer*	29.835	5	4
289.	Tchagra, Black-crowned	Swartkroontjagra	*Tchagra senegalus*	16.005	4	4

290.	Tchagra, Brown-crowned	Rooivlerktjagra	*Tchagra australis*	11.4	4	4
291.	Teal, Cape	Teeleend	*Anas capensis*	2.375	3	3
292.	Teal, Hottentot	Gevlekte Eend	*Anas hottentota*	2.185	2	2
293.	Teal, Red-billed	Rooibekeend	*Anas erythrorhyncha*	25.59	5	4
294.	Tern, Caspian	Reusesterretjie	*Sterna caspia*	0.185	1	0
295.	Tern, Whiskered	Witbaardsterretjie	*Chlidonias hybrida*	12.56	5	1
296.	Tern, White-winged	Witvlerksterretjie	*Chlidonias leucopterus*	6.75	5	0
297.	Thick-knee, Spotted	Gewone Dikkop	*Burhinus capensis*	38.45	5	4
298.	Thrush, Groundscraper	Gevlekte Lyster	*Psophocichla litsipsirupa*	17.475	4	4
299.	Thrush, Karoo	Geelbeklyster	*Turdus smithi*	73.26	5	4
300.	Thrush, Kurrichane	Rooibeklyster	*Turdus libonyanus*	21.7	4	4
301.	Tinkerbird, Yellow-fronted	Geelblestinker	*Pogoniulus chrysoconus*	5.36	4	4
302.	Tit, Ashy	Akasiagrysmees	*Parus cinerascens*	2.995	3	3
303.	Tit, Southern Black	Gewone Swartmees	*Parus niger*	2.055	2	2
304.	Tit-babbler, Chestnut-vented	Bosveldtjeriktik	*Parisoma subcaeruleum*	17.495	4	4
305.	Turtle-dove, Cape	Gewone Tortelduif	*Streptopelia capicola*	90.355	5	4
306.	Wagtail, African Pied	Bontkwikkie	*Motacilla aguimp*	0.935	1	1
307.	Wagtail, Cape	Gewone Kwikkie	*Motacilla capensis*	63.02	5	4
308.	Warbler, Garden	Tuinsanger	*Sylvia borin*	1.78	2	0
309.	Warbler, Marsh	Europese Rietsanger	*Acrocephalus palustris*	3.455	2	0
310.	Warbler, Sedge	Europese Vleisanger	*Acrocephalus schoenobaenus*	0.47	2	0
311.	Warbler, Willow	Hofsanger	*Phylloscopus trochilus*	12.735	4	0

312.	Waxbill, Blue	Gewone Blousysie	*Uraeginthus angolensis*	4.865	4	4
313.	Waxbill, Common	Rooibeksysie	*Estrilda astrild*	30.11	5	4
314.	Waxbill, Orange-breasted	Rooiassie	*Amandava subflava*	15.56	5	4
315.	Waxbill, Violet-eared	Koningblousysie	*Granatina granatina*	0.095	2	2
316.	Weaver, Cape	Kaapse Wewer	*Ploceus capensis*	26.8	4	4
317.	Weaver, Thick-billed	Dikbekwewer	*Amblyospiza albifrons*	14.77	4	4
318.	Weaver, Village	Bontrugwewer	*Ploceus cucullatus*	8.3	2	2
319.	Wheatear, Capped	Hoeveldskaapwagter	*Oenanthe pileata*	16.655	4	4
320.	Wheatear, Mountain	Bergwagter	*Oenanthe monticola*	17.195	4	4
321.	White-eye, Cape	Kaapse Glasogie	*Zosterops virens*	72.225	5	4
322.	Whydah, Pin-tailed	Koningrooibekkie	*Vidua macroura*	31.985	5	4
323.	Whydah, Shaft-tailed	Pylstertrooibekkie	*Vidua regia*	0.095	1	1
324.	Widowbird, Fan-tailed	Kortstertflap	*Euplectes axillaris*	4	2	2
325.	Widowbird, Long-tailed	Langstertflap	*Euplectes progne*	41.175	5	4
326.	Widowbird, Red-collared	Rooikeelflap	*Euplectes ardens*	31.66	4	4
327.	Widowbird, White-winged	Witvlerkflap	*Euplectes albonotatus*	41.39	4	4
328.	Wood-hoopoe, Green	Rooibekkakelaar	*Phoeniculus purpureus*	55.14	5	4
329.	Woodpecker, Bearded	Baardspeg	*Dendropicos namaquus*	4.49	1	1
330.	Woodpecker, Cardinal	Kardinaalspeg	*Dendropicos fuscescens*	13.195	4	4
331.	Woodpecker, Golden-tailed	Goudstertspeg	*Campethera abingoni*	6.925	4	4
332.	Wryneck, Red-throated	Draaihals	*Jynx ruficollis*	30.105	4	4

Totals	0	0	44 (13.25%)
	1	36 (10.84%)	30 (9.04%)
	2	42 (12.65%)	41 (12.35%)
	3	51 (15.36%)	44 (13.25%)
	4	97 (29.22%)	165 (49.70%)
	5	106 (31.93%)	8 (2.41%)
Total threatened Species expected to occur within and around the study area.	***21***		

Of the 332 bird species listed in **Table 1**, 203 species (61.15%) were either confirmed to occur or are highly likely to occur in or around the study area of which 173 species are likely to breed on or near the study area. 51 of the 176 listed bird species have a medium occurrence probability and 78 a low to very low occurrence probability.

Twenty-one threatened bird species have previously been recorded within the 2528CD QDS and are listed in **Table 2**. On account of the availability habitats on the study area as well as specific habitat preferences the occurrence probability of 9 of these species was deemed to be possible.

Red Data Bird Species

Red Data bird species previously recorded within the 2528CD QDS according to Harrison *et al*. (1997), Tarboton *et al*. (1987), SABAP2 (**Table2**).

Table 2: Red Data bird species recorded for the 2528CD QDS to date.

	Species name	Last Recorded (Year)	Red Data: (Regional; Global)	Taxonomic name	Rep Rate (%)	HP	Br
1.	Crane, Blue	2016	NT, VU	*Anthropoides paradiseus*	3.585	3	2
2.	Duck, Maccoa	2014	NT, NT	*Oxyura maccoa*	4.935	3	3

3.	Eagle, Tawny	Prior to 2007	**EN,LC**	*Aquila rapax*	0.10	1	0
4.	Eagle, Verreauxs'	2013	**VU, LC**	*Aquila verreauxii*	1.135	1	0
5.	Falcon, Lanner	2009	**VU, LC**	*Falco biarmicus*	4.47	3	0
6.	Falcon, Red-footed	Prior to 2007	**NT, NT**	*Falco vespertinus*	0.185	2	0
7.	Flamingo, Greater	2016	**NT, LC**	*Phoenicopterus ruber*	4.095	4	0
8.	Flamingo, Lesser	2014	**NT, NT**	*Phoenicopterus minor*	2	2	0
9.	Grass-owl, African	Prior to 2007	**VU, LC**	*Tyto capensis*	0.655	1	0
10	Harrier, Pallid	2008	**NT, NT**	*Circus macrourus*	0.67	1	0
11	Kingfisher, Half-collared	2015	**NT, LC**	*Alcedo semitorquata*	1.135	3	3
12	Korhaan, Blue	Prior to 2007	**NT, NT**	*Eupodotis caerulescens*	0.185	2	2
13	Korhaan, White-bellied	Prior to 2007	**VU, LC**	*Eupodotis senegalensis*	0.095	2	2
14	Lark, Melodious	2009	**NT, LC**	*Mirafra cheniana*	0.935	1	1
15	Marsh-harrier, African	-	**EN, LC**	*Circus ranivorus*	0	1	0
16	Painted-snipe, Greater	Prior to 2007	**NT, LC**	*Rostratula benghalensis*	0.095	1	0
17	Pratincole, Black-winged	2016	**NT, NT**	*Glareola nordmanni*	4.185	2	0
18	Secretarybird,	2012	**VU, VU**	*Sagittarius serpentarius*	3.125	3	1
19	Stork, Abdim's	Prior to 2007	**VU, VU**	*Ciconia abdimii*	1.125	3	0
20	Stork, Black	Prior to 2007	**VU, LC**	*Ciconia nigra*	0.185	1	0
21	Tern, Caspian	Prior to 2007	**VU, LC**	*Sterna caspia*	0.185	1	0

Red data species Categories for the Birds of Southern Africa (Birdlife South Africa 2015)

LC = Least Concern, **NT** = Near Threatened, **VU** = Vulnerable, **EN** = Endangered, **CR** = Critically Endangered.

A total of 21 threatened and near threatened bird species have previously been recorded within the 2528CD QDS (**Table 2**). Eleven of which have not yet been recorded within the 2545_2820, 2550_2820 and 2555_2820 pentad since the commencement of the South African Bird Atlas Project 2 in 2007; with the exception of African Grass-owl the remaining 10 species are highly unlikely to recur as they have not been recorded in the pentad within the past 9 years. African Grass-owl records are generally low as a result of their nocturnal habits, thus the possible occurrence of this species remains highly likely even though it has not been recorded in recent years. Eight of the 21 species have been recorded within the 2528CD QDS during the past five years. On account of the habitats present within the study area these species are likely to recur or be resident within the associated habitats.

6. Findings

The discrete habitats identified on the study area supports a large variety of bird species; approximately 254 have a high to medium occurrence probability, of which 9 threatened and near threatened avifaunal species are likely to recur and/or be resident. The following findings were made for each of the associated habitat units within the larger study area.

- **Mixed Residential and Agricultural:** As a result of the lack of suitable breeding habitat for threatened avifauna as well as the numerous disturbances associated with agricultural activities this habitat type was deemed to have a reasonably low avifaunal sensitivity.
- **Savanna Grassland:** No suitable breeding habitat for any threatened bird species were observed on site, however the habitat might be suitable in terms of foraging and hunting for certain threatened and near threatened species such as Lanner Falcons. On account of the near natural state of the study unit together with the overall high avifaunal species composition, this study unit was deemed moderately sensitive from an avifaunal perspective.
- **Near Natural Grassland:** On account this habitat unit's connectivity function, optimal habitat for threatened and near threatened bird species, natural state of the habitat and unique species composition the largest part of this habitat was deemed to be moderately sensitive from a avifaunal perspective.

  One section of this habitat unit was deemed to be highly sensitive as it is located between two highly sensitive wetland sections and connects two of the three near natural grassland habitats in the southern portion of the study area. This highly sensitive section of the near natural grassland provides the optimal breeding and foraging habitat for Grass-owls.
- **Rocky Ridge:** The habitat unit was found to have a high avifaunal species richness as well as a high species density. No threatened bird species were observed or are expected to be resident within this study unit, however, it remains suitable in terms of foraging and hunting for certain threatened and near threatened species.

  On account of the pristine natural avifaunal habitat and the critical connectivity function fulfilled by this study unit the habitat was deemed to be highly sensitive from an avifaunal perspective.
- **Wetland:** The wetland habitat is largely intact apart from some man-made and agricultural disturbances such as dam walls and recreational use activities. In terms of habitat connectivity this study unit forms part of a largely undisturbed and well connected wetland network of approximately 490 ha. As a result of the intact and undisturbed nature of the wetland habitat along with the optimal habitat it provides for a number of

threatened and near threatened bird species this study unit was deemed highly sensitive from an avifaunal standpoint.

- **Riverine vegetation:** Although disturbances in the form of berms, water extraction, recreational use and alien vegetation encroachment along both watercourses are evident, connectivity to homogeneous habitats are very good and promotes the movement of bird species.
  Due to the connectivity function, high avifaunal diversity and optimal habitat for the near threatened Half-collared Kingfisher this habitat unit was deemed to be highly sensitive.
- The Urban area and Mixed Alien Vegetation habitat units were deemed to have a low avifaunal sensitivity on account of the various disturbances within these areas as well as their avifaunal species composition.

7. Limitations

The majority of the data used to conclude the distribution of Red Data species were sourced by making use of the SABAP 1 and 2 data bases. Any limitations in the above mentioned studies will in effect have implications on the findings and conclusion of this assessment. Furthermore this avifaunal assessment was conducted during April; hence the survey was done outside the main breeding period of the local bird species. Moreover, most of the Palearctic and intra-Africa migratory bird species have commenced their migration to the North by this time. With respect to this assessment the implications of not being able to record migratory bird species will be minimal, seeing as most are threatened in their Northern hemisphere distributions.

Limited time to conduct the survey could potentially result in not recording all species within the study area. The study site was visited on the 2 of March, and on the 21 and 22 April 2016 for 6 hours per day. In total 18 hours were spent on site while conducting this avifaunal assessment. As a result of the size of the study area, 18 hours was deemed sufficient time to record all the resident bird species on and around the study area.

8. Recommendations

- Prior to any activities commencing on site, all construction staff should be briefed in an environmental induction regarding the environmental status and requirements of the site. This should include providing general guidelines for minimizing environmental damage during construction, as well as education with regards to basic environmental ethics, such as the prevention of littering, lighting of fires, etc.
- Induction should be done for all civil contractors and for each building contractor prior to them commencing on site.

- Areas where construction is to take place should be clearly demarcated and fenced off, all areas outside that of the defined works should be deemed no-go areas.
- All construction activities must be restricted to the demarcated areas to ensure that no further disturbance into the surrounding vegetation or habitat takes place.
- It is recommended that prior to the commencement of construction activities' initial clearing of all alien vegetation should take place.
- The contractor must ensure that no avifaunal species are trapped, killed or in any way disturbed during construction. Collecting of eggs such as Guineafowl present on site should not be tolerated.
- It is recommended that all concrete and cement works be restricted to areas of low ecological sensitivity and defined on site and clearly demarcated. Cement powder has a high alkalinity pH rating, which can contaminate and affect both soil and water pH dramatically. A shift in the pH can have serious consequences on the functioning of soil, vegetation and fauna.
- To ensure minimal disturbance of avifaunal species it is recommended that construction should take place during winter, outside the breeding season of the species present on site.
- Construction, vegetation clearing and top soil clearing should commence from a predetermined location and gradually commence to ensure that birds and other fauna present on the site have enough time to relocate.
- When construction is completed, disturbed areas should be rehabilitated using vegetation cleared prior to construction to ensure that the habitat stays intact and that faunal species present on the site before construction took place, return to the area.
- Since significant ridges are present on the proposed development property, as well as the large areas of irreplaceable areas
- The attached sensitivity map should be used as a decision tool to guide the layout design.
- All areas designated as sensitive in the sensitivity map (**Figure 13**) should be incorporated into an open space system. Development should be located on areas of medium to low sensitivity.
- The open space system should be managed in accordance with the EMP that complies with the Minimum Requirements for Ecological Management Plans and forms part of the EMP.
- Since significant ridges are present on the proposed development area, as well as irreplaceable areas as determined by the Gauteng C-Plan V3.3, the proposed development must comply with all the objectives, requirements and guidelines as stipulated in GDARD's Revised Ridges Policy 23 June 2006.

9. Conclusion

The study area contains a total of 8 distinct habitats of which the Urban Area and Mixed Residential and Agricultural habitat units were deemed to have a low avifaunal sensitivity. The Savanna Grassland and Near Natural Grassland were judged to have a medium avifaunal sensitivity with the exception of a section of the Near Natural Grassland deemed to be highly sensitive on account of its connectivity function. The Rocky Ridge, Riverine Vegetation and Wetland habitat units were deemed to be highly sensitive on account of various factors as discussed under the sub-heading titled Findings. Development within the habitat units deemed to have a high avifaunal sensitivity should be restricted as far as possible (**Figure 14**).

Although 21 threatened and/or near threatened bird species have been recorded within the larger 2528CD QDS, only 9 of these species are judged to still occur and/or be resident within the study area. These species are highly specialized and restricted to their associated habitats as stipulated in this report, thus care should be taken to preserve these unique habitats by restricting disturbances and minimizing transformation in these areas.

Special attention should be assigned to ensure that connectivity of homogeneous habitats stays intact as connectivity of the various habitat units with surrounding homogenous habitats is mandatory to ensure sustainable demographic patterns of avifaunal species relying on certain habitats for survival.

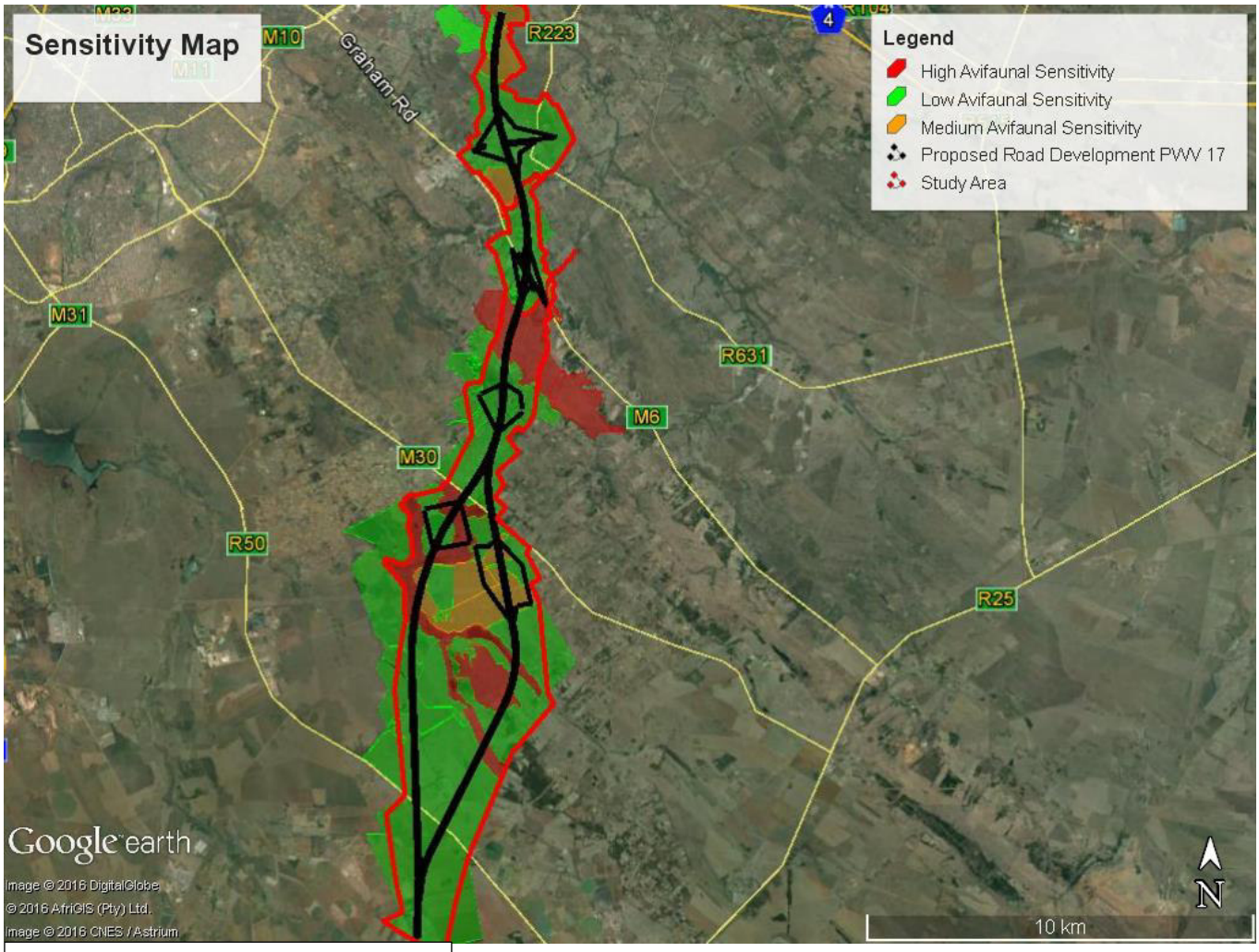

Figure 13: Avifaunal Sensitivity Map

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Annexure E (ii)

Wetland and Soils

PWV 17

Soil Assessment Report

March 2016

Landscape Architects &

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Declaration of independence:

The specialist investigators responsible for conducting this particular specialist study declare that:

- We consider ourselves bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);

- At the time of conducting the study and compiling this report we did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in a professional capacity;

- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, we will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being members of the general public;

- We declare that there are no circumstances that may compromise our objectivity in performing this specialist investigation. We do not necessarily object to or endorse the proposed development, but aim to present facts, findings and recommendations based on relevant professional experience and scientific data;

- We do not have any influence over decisions made by the governing authorities;

- Should we, at any point, consider ourselves to be in conflict with any of the above declarations, we shall formally submit a Notice of Withdrawal to all relevant parties and formally register as an Interested and Affected Party;

- We undertake to disclose all material information in our possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by a competent authority to such a relevant authority and the applicant;

- We have the necessary qualifications and guidance from professional experts (registered Pr. Nat. Sci.) in conducting specialist reports relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;

- This document and all information contained herein is and will remain the intellectual property of Bokamoso Environmental consultants: Specialist Division. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the specialist investigators.

- We will comply with the Act, regulations and all other applicable legislation;

- All the particulars furnished by us in this document are true and correct.

G. van Rooyen

VERIFICATION STATEMENT

This communication serves to verify that the wetland assessment completed by G. van Rooyen was reviewed under my supervision, and I have verified the contents thereof. Overall the report achieves the stated aim of delineating the wetland primarily using soil characteristics. The principles, methods, and approach are scientifically valid.

ECOLOGICAL REVIEW: PWV17

Declaration of independence: I, Dr. J. Dabrowski (Pr.Sci.Nat, Reg. No. 115166) declare that I:

- Am committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas I appreciate the opportunity to learn through the processes of constructive criticism and debate, I reserve the right to form and hold our own opinions. Therefore will not willingly submit to the interests of other parties, be they the client or the relevant competent authorities, nor change my statements to appease them;
- Abide by the Code of Ethics of the S.A. Council for Natural Scientific Profession;
- Act as an independent specialist consultant in the fields of aquatic science and ecology
- Am contracted as a subconsultant by Bokamoso Environmental consultants for the proposed PWV17 Wetland delineation as described in the report;
- Do not have or will not have any financial interest in the undertaking of the activity, other than remuneration for work performed;
- Have or will not have any vested interest in the proposed activity proceeding;
- Have no and will not engage in conflicting interests in the undertaking of the activity;
- Undertake to disclose to the client and the competent authority any material information that has or may have the potential to influence the decision of the competent authority, as required in terms of the Environmental Impact Assessment Regulations 2014.

Overall the report appears to be relevant, detailed enough for the purposes of this study and complete and finally addressing the key issues at stake.

Dr. Jackie Dabrowski, *Pr.Sci.Nat (Aquatic Science)*

Table of contents

1. INTRODUCTION

South Africa is classified as an arid country, receiving an average annual rainfall of about 464mm. The world average is 860mm of rainfall annually, which emphasises South Africa's status as an arid country (South Africa info, 2015). Owing to this relatively low rainfall, wetlands in South Africa are very important resources. Wetlands regulate runoff processes as well as protect scarce water resources. Wetlands act like sponges, in the sense that they have a strong ability to hold onto water during flooding and also demonstrate the ability to release stored water during dry periods (droughts). Wetlands also have the ability to remove pollutants from water such as heavy metals and organisms which may cause disease (DWAF, 2005). Wetlands also provide habitats for many species, on which these species rely on the wellbeing of the wetland. Wetlands in South Africa are under threat due to anthropogenic activities. Studies suggest that over half of all wetlands in South Africa have already been destroyed (DWAF, 2005).

1.1 Project description

A wetland soil assessment (Hydropedology) was required for the proposed development (freeway) located on the eastern side of Pretoria all the way down to the east rand of Johannesburg. The assessment focused on the delineation of the wetland according to soil forms and wetness indicators. The study site has numerous land uses throughout the proposed linear development. The study site currently has land occupants in the form of agricultural farms, game farms, residences and natural vegetation areas.

Bokamoso Environmental Consultants specialist division was appointed to conduct a wetland study (Hydropedology). This report focuses on the soil types and soil properties of the site. In order for the proposed site to be fully understood, this report should be understood along with other specialist reports.

1.2 Limitations and methodology

A wetland study should ideally be conducted over a period of years and different seasons as to create a complete understanding of the site. The site assessment was conducted during only one season and the data obtained should be considered in conjunction with conservation authorities as well as other professional studies. A major limitation to the study was access to certain areas due to farm boundaries and inaccessible areas.

A field survey was conducted between 18 February and 2 March 2016. The assessment was based on the Department of Water and Forestry "A practical field procedure for identification and delineation of wetlands and riparian areas", also known as DWAF (2005). The assessment was also based on experience and knowledge of hydric soils. The assessment involved the use of aerial photography, historical aerial photography and Geographic Information Systems (GIS) as part of the desktop study.

1.3 Background and description of site

Figure 1: Locality of proposed development of PWV 17 Freeway

The purpose of the proposed freeway is to connect the East Rand more directly with the eastern suburbs of Pretoria. It also offers an eastern bypass of the Johannesburg and Pretoria regions.

The study site traverses areas of dolomite in the southern section. Towards the northern section of the site, the study site and proposed development goes up and over the Bronberg mountain which forms part of the Magaliesburg mountain range. The site also crosses several rivers and streams as well as wetland sensitive areas (discussed later in the report). The study site also occurs outside of the urban edge, except for a small portion located towards the north of the study site.

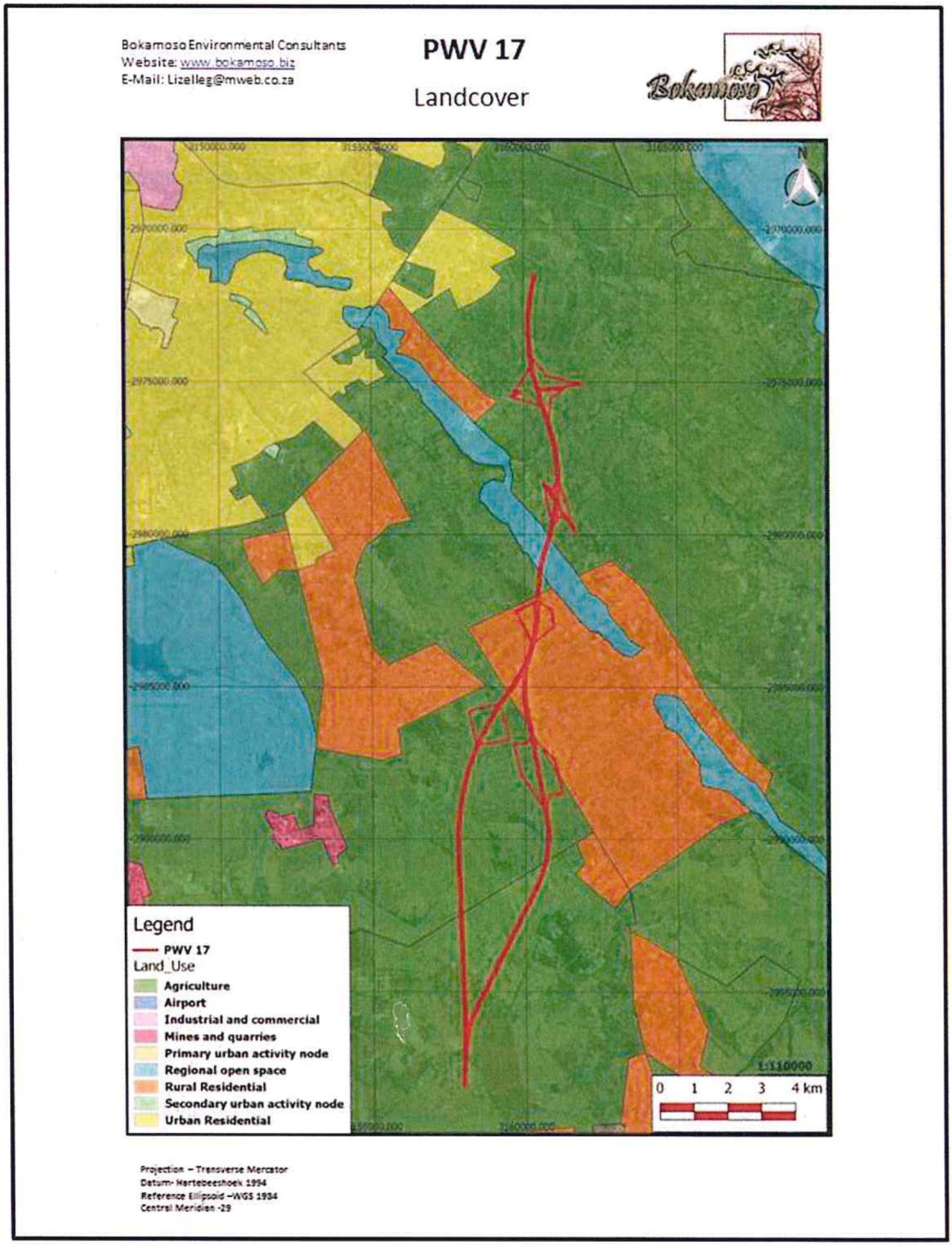

Figure 2: Landcover of PWV 17

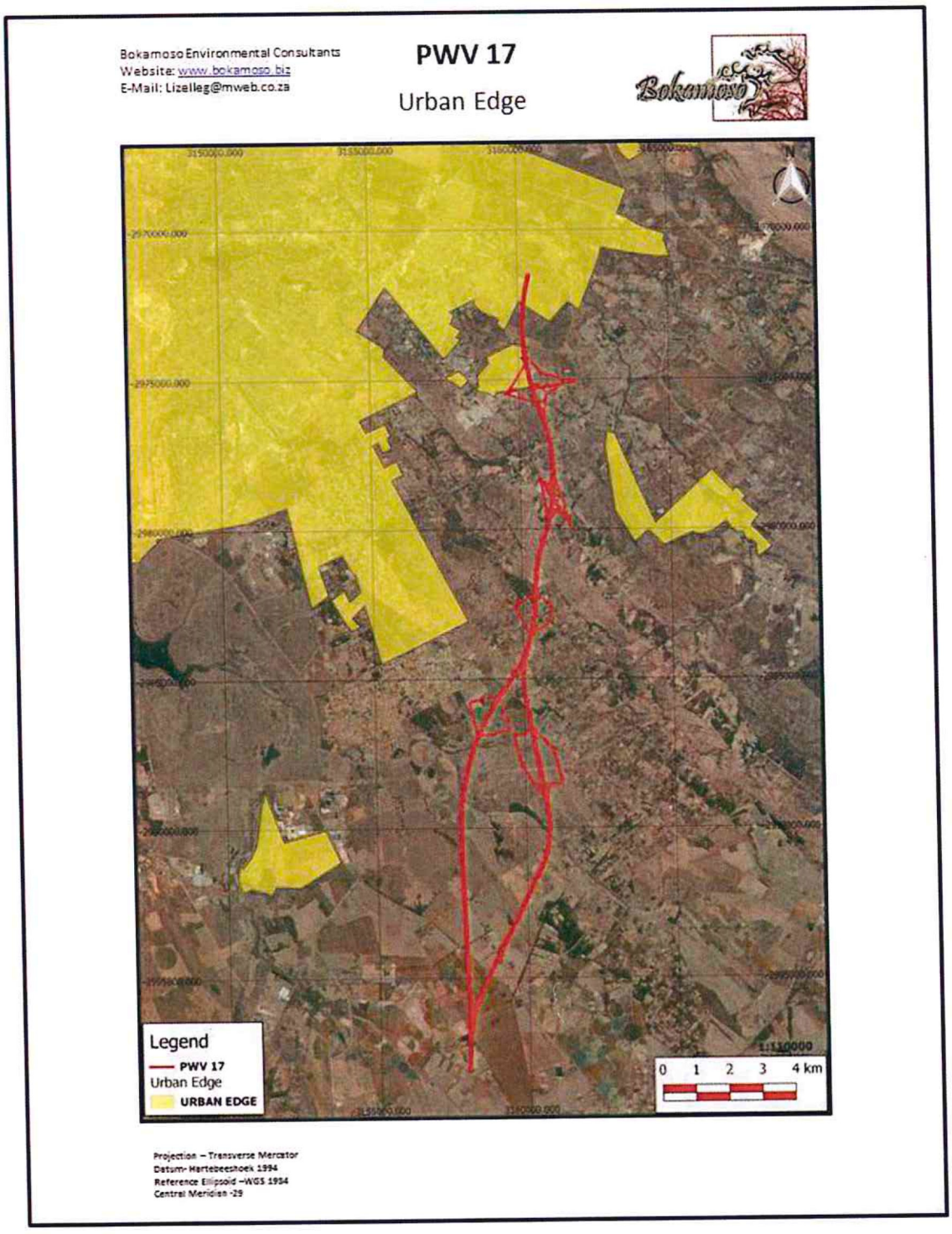

Figure 3: Urban edge